# EDGE

# PresencePLUS® P4

user's manual

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P/N 120413

**WARNING . . . Not to be Used for Personnel Protection**

**Never use these products as sensing devices for personnel protection. Doing so could lead to serious injury or death.**

These sensors do NOT include the self-checking redundant circuitry necessary to allow their use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition. Consult your current Banner Safety Products catalog for safety products which meet OSHA, ANSI and IEC standards for personnel protection.

This User’s Manual reflects Sensor Firmware Version 1.0.0 and GUI Software Version 2.0.2.

# Warnings and Cautions

Read all warnings and cautions in this section before working with the PresencePLUS P4 system (also referred to as *the Sensor*).

## ⚠ Safety Warnings

**Observe the following warnings to avoid personal injury:**

- Never use the Sensor as a sensing device for personnel protection. Such use could create an unsafe condition that could lead to serious bodily injury or death.
- Before connecting or disconnecting any cables, be sure the power supply is OFF.

## ⚠ Cautions

**Observe the following cautions to avoid damage to the Sensor:**

- Never connect the Sensor to a power source other than 10–30V dc.
- Keep components at least 250 mm (10") away from power cables.
- Keep components away from high-voltage power sources and motors.

## ⚠ Electrostatic Discharge Caution

**Avoid the damage that electrostatic discharge (ESD) can cause to the Sensor.**

Always use a proven method for preventing electrostatic discharge when installing a lens or attaching a cable.

## ⚠ User Service Caution

**The Sensor has no field-replaceable or user-serviceable components.**

To avoid invalidating the Banner warranty, do not disassemble or make electrical or mechanical modifications to any components.

## Environmental Requirements

**For reliable operation, the installation location must meet the following criteria:**

- Stable ambient temperature: 0° to +50° C (+32° to 122° F)
- Ambient relative humidity: 35% to 90%, non-condensing
- Stable ambient lighting: no large, quick changes in light level; no direct or reflected sunlight
- No excessive vibration or mechanical shock
- No contact with corrosive or volatile materials or atmosphere
- No liquid splash
- Minimal dust or dirt

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# 1. Product Support and Maintenance

This section provides general Banner resources and specific documentation, warnings, and cautions for installers and operators of the PresencePLUS P4 Sensor.

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# Product Support

Banner provides the following resources for quickly setting up and operating the Sensor.

## Documentation

The following documentation is available in PDF format on the PresencePLUS P4 software CD and on the Banner website. A compatible version of Acrobat Reader is provided on the CD. PresencePLUS P4 documentation is in the **Vision Product Line** list on the following Banner website page:

www.bannerengineering.com/literature_resources/product_literature

**PresencePLUS P4 QuickStart Guide P/N 118000:** An overview of setting up and using PresencePLUS P4 Sensors to run inspections.

**Help Files:** The PresencePLUS P4 Help files provide convenient access to detailed instructions for setting up and running inspections. These online Help files are included with the Sensor and can be viewed from the CD.

## Banner Website

The most current PresencePLUS P4 information, documentation, and software updates are available at the following Banner website page:

www.bannerengineering.com/literature_resources/software_eds/soft_results.php

## Factory Support

Call, e-mail, fax, or write your local Banner representative or a Banner Applications Engineer for support. Applications Engineers are available from 8:00 A.M. to 5:00 P.M. Central Time, Monday through Friday, excluding holidays.

| | |
|---|---|
| **Phone** | **Local**: (763) 544-3164<br>**Toll free:** 1-888-3-SENSOR (1-888-373-6767) |
| **Fax** | (763) 544-3213 |
| **E-mail** | sensors@bannerengineering.com |
| **Address** | Banner Engineering Corp.<br>9714 10th Avenue North<br>Minneapolis, MN 55441<br>USA |
| **Your Local Banner Representative** | Affix your local Banner representative's business card here (if reading this online, print this page). |

To help Banner better assist you, be ready to provide the following information:

- PresencePLUS P4 software version (to find version number, click **Help** in the Main Menu toolbar and choose **About**)
- Operating system of your PC
- Sensor Model Number and Date Code. Model Number is on top of Sensor, Date Code is either on the bottom or the side.
- Exact wording of any messages that appeared on your screen
- A description of what you were doing and what happened
- A description of how you tried to solve the problem

## Warranty

Banner Engineering Corp. warrants its products to be free from defects for one year. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture found to be defective at the time it is returned to the factory during the warranty period. This warranty does not cover damage or liability for the improper application of Banner products. This warranty is in lieu of any other warranty, either expressed or implied.

Banner Engineering Corp. assumes no liability for damages resulting from the use of this manual.

Content of printed manuals and online help subject to change without notice.

# Maintenance

Maintenance tasks include keeping the hardware free of dust and dirt and updating the PresencePLUS P4 software as new versions become available.

## Cleaning the Sensor

Regularly remove any dust or dirt from the Sensor using a soft cloth. If needed, slightly dampen the cloth with a weak solution of neutral detergent. Avoid getting dirt on the imager (the area behind the lens). If the imager is dirty, use anti-static compressed air to blow off the dust.

## Cleaning the Lens

Regularly remove dust, dirt, or fingerprints from the lens. Use anti-static compressed air to blow off dust. If necessary, use a lens cloth and lens cleaner or window cleaner to wipe off remaining debris.

Do not use any other chemicals for cleaning.

## Updating the PresencePLUS P4 Software

The current version of PresencePLUS P4 software is available for download from the Banner website. See Banner Website on page 2.

# 2. System Overview

This section introduces the PresencePLUS P4 EDGE system and the software.

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## Sensor Description

The PresencePLUS P4 EDGE Sensor is an easy-to-use vision sensor with advanced visual inspection capabilities. With minimal knowledge of vision systems, a user can quickly set up the Sensor and run an inspection that tests all products and accurately rejects bad products on a production line.

Inspections are set up using a remote personal computer (PC) or by activating the Remote Teach input. The Sensor captures images, and its software analyzes the images using one or more Vision tools to pass or fail the product. The PC is not required for running inspections after the inspection files have been stored in the Sensor's memory.

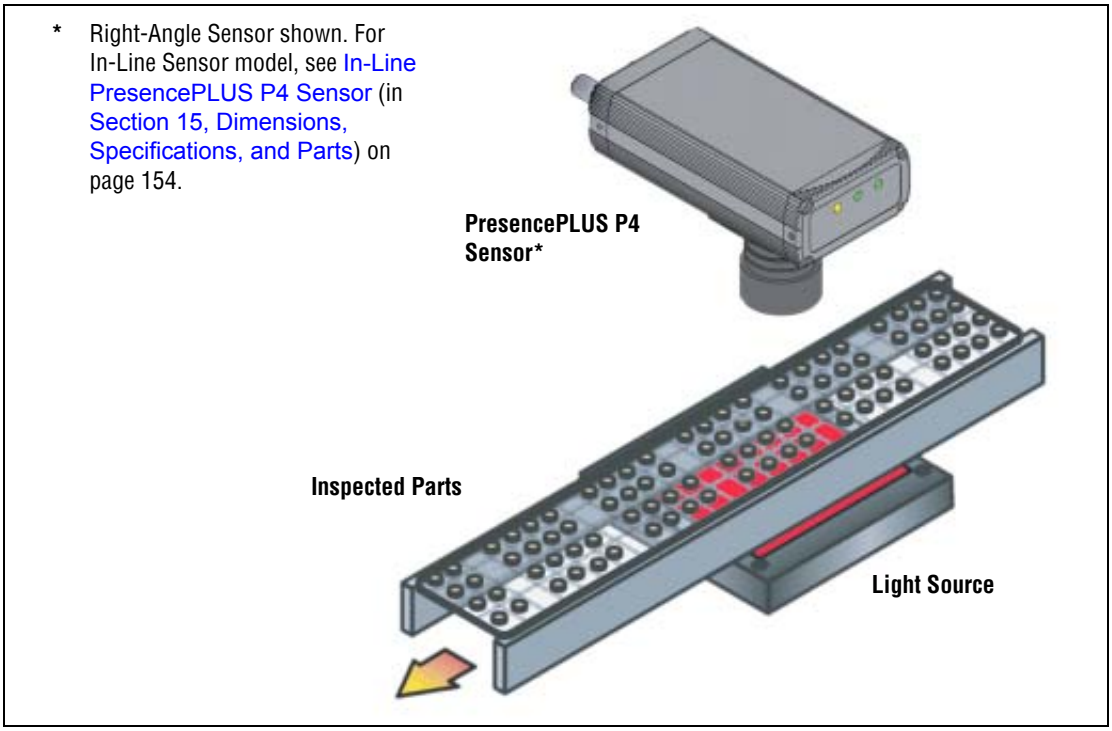
Inspection setup involves focusing the lens and selecting the appropriate Analysis tools or by activating the Remote Teach input. The full range of inspection parameters can be established either automatically or manually. The automatic Teach function eliminates the iterative process of determining correct parameters.

The Sensor accommodates both translational and rotational variation. Parts moving down a production line or web need not be oriented in exactly the same way.

The Sensor is self-learning and easy to operate, with both basic and advanced options. For basic options, new users can follow the guided Setup sequence. Advanced users can override automatic settings and create highly customized inspections.

# Typical Application

A typical PresencePLUS P4 application is shown below.


* Right-Angle Sensor shown. For In-Line Sensor model, see In-Line PresencePLUS P4 Sensor (in Section 15, Dimensions, Specifications, and Parts) on page 154.
PresencePLUS P4 Sensor*
Inspected Parts
Light Source

***Typical PresencePLUS P4 Application***

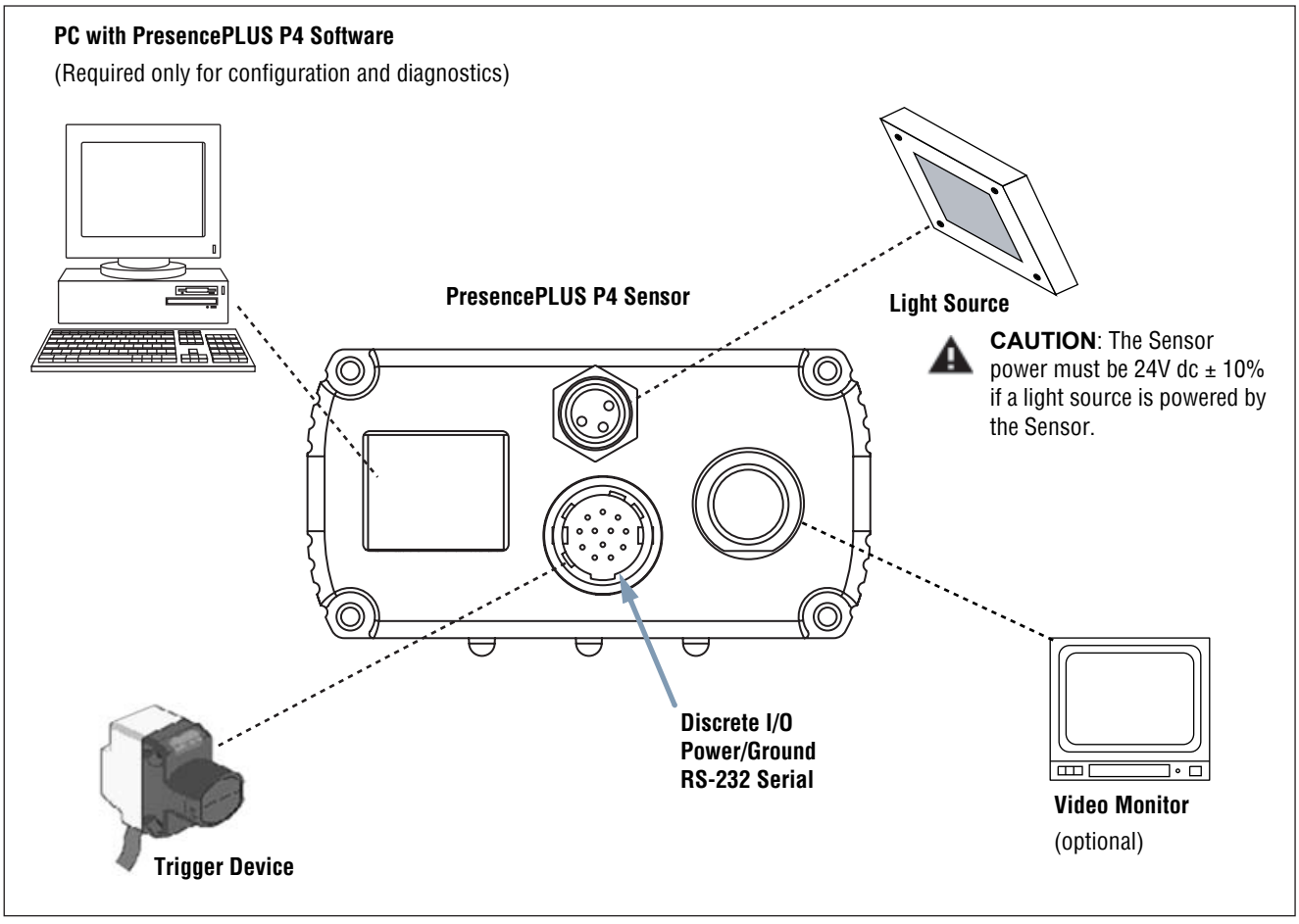
# Components and Connections

For detailed information about each system component and instructions on installing the components and software, see Section 3, Installation beginning on page 9 and the Installation section of the PresencePLUS P4 EDGE help files.

## Components

The PresencePLUS P4 system consists of the Sensor and a PC with PresencePLUS P4 software and the appropriate connections. The Sensor requires lighting and a trigger device, and an optional video monitor can be connected.

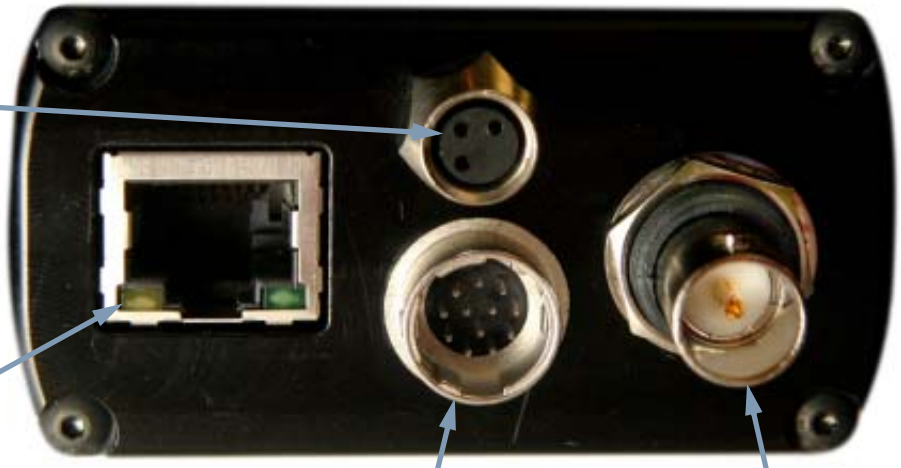
| | |
|---|---|
| **TIP** | The trigger device can be any 10–30V dc photoelectric sensor or a device with a similar output. |


PC with PresencePLUS P4 Software
(Required only for configuration and diagnostics)
PresencePLUS P4 Sensor
Light Source
CAUTION: The Sensor power must be 24V dc ± 10% if a light source is powered by the Sensor.
Discrete I/O
Power/Ground
RS-232 Serial
Video Monitor
(optional)
Trigger Device

***PresencePLUS P4 Components***

## Cable Connections

The PC, external light source, and optional video monitor are attached to the Sensor hookups shown in the following diagram.




**Crossover Ethernet Cable (to PC Ethernet Port)***

**STPX07** — 2.1 m (7')

**STPX25** — 7.6 m (25')

or

**Standard Ethernet Cable (to PC via Network Hub or Switch)**

**STP07** — 2.1 m (7')

**STP25** — 7.6 m (25')

**Monitor Cable (to Video Monitor, optional)**

**BNC06** — 2 m (6')

**BNC15** — 5 m (15')

**BNC30** — 9 m (30')

**Serial Cable (to PC Serial Port)***

**DB9P06** — 2 m (6')

**DB9P15** — 5 m (15')

**DB9P30** — 9 m (30')

* The Sensor can be connected to the PC via a serial cable or an Ethernet network; Ethernet provides faster communication.

| Pin # | Wire Color | Description | Direction |
|---|---|---|---|
| 1 | Yellow | RS-232 TX | Output |
| 2 | Gray | Remote Teach | Input |
| 3 | Orange | Product Change | Input |
| 4 | Pink | External Trigger | Input |
| 5 | Black | I/O #1 | In/Out |
| 6 | Red | I/O #2 | In/Out |
| 7 | White | I/O #3 | In/Out |
| 8 | Light Blue | I/O #4 | In/Out |
| 9 | Violet | RS-232 RX | Input |
| 10 | Green | RS-232, Signal Ground | Output |
| 11 | Blue | Common, Signal Ground | Output |
| 12 ⚠ | Brown | 10-30V dc | Input |

⚠ **CAUTION:** The Sensor power must be 24V dc ± 10% if a light source is powered by the Sensor.

***Cable Connections***

# 3. Installation

This section provides Sensor hardware and software installation instructions.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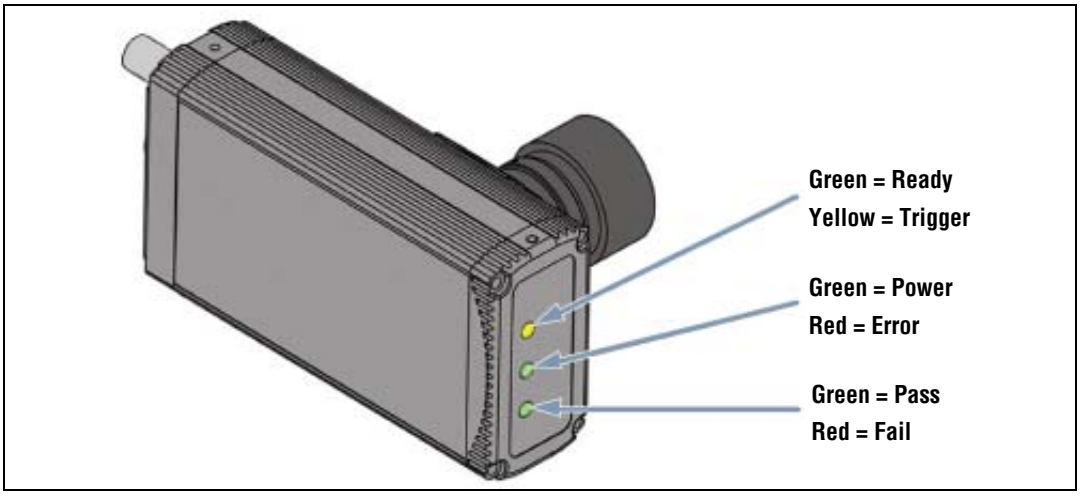
# Hardware Installation Overview

Following is an overview of the procedure for connecting and powering up the basic hardware. Details are provided in the subsections that follow.

1. Read Warnings and Cautions on page i.
2. Check for the following essential components:
   - Lens
   - Sensor and cable
   - Communication cable (Ethernet or serial)
   - 486 microprocessor or faster personal computer running Microsoft Windows ME, NT, 2000, or XP operating system
   - Power supply with 10–30V dc and 500 mA maximum current
   - Light source. Every application requires a light source; however the Sensor can be used without a dedicated light source.
   - Trigger source (example: Banner WORLD-BEAM® QS18VN6D sensor)
3. Thread the lens onto the Sensor's lens mount.
4. Connect the communication cable between the PC and Sensor.
5. Connect the trigger source (see step 2 above) to the Sensor as follows:
   a) Connect brown wire to +V dc.
   b) Connect blue wire to –V dc.
   c) Connect black wire to pink wire from Sensor cable.
6. Connect the power supply to the Sensor as follows:
   a) Connect +V to brown wire of cable.
   b) Connect –V to blue wire of cable.

| ⚠ CAUTION | The Sensor alone will operate properly with input voltage of 10–30V dc; however, if a light source is powered by the Sensor, input voltage must be 24V dc ± 10%. |
|---|---|

7. Power up the hardware and verify that the Red Error LED turns OFF. During power-up, all the Sensor LEDs turn ON for 15 to 20 seconds (see below).
8. Install PresencePLUS P4 software on the host PC (see Software Installation on page 19).
9. Start the PresencePLUS P4 program and verify system connections (see Startup and Troubleshooting on page 20).




***PresencePLUS P4 LEDs***

# Hardware Installation

Before installing any hardware, read Warnings and Cautions on page i.

## Mounting the Sensor

Mount the Sensor securely. Optional Banner mounting brackets for PresencePLUS P4 Sensors are available. See Right-Angle Sensor Mounting Bracket (shown on page 153) and In-Line Sensor Mounting Bracket (shown on page 155) in Section 15, Dimensions, Specifications, and Parts.

### Cable Bend Relief

Allow at least 75 mm (3") clearance at the rear of the Sensor for cable bend relief.

### Mounting Hardware

The following mounting hardware is supplied with all brackets:

- Four M3 x 0.5 x 6 mm socket head cap screws
- Four medium split lock washers
- Four flat washers
- Short-arm hex key wrench

## Mounting the Light Source

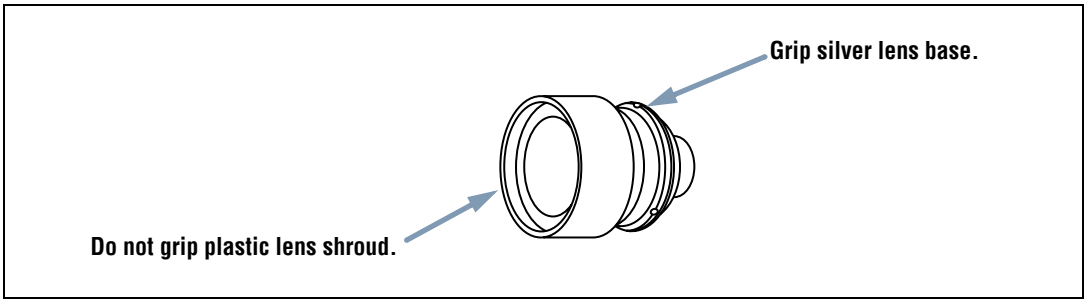
The light source must be securely mounted. Any movement in the light source during an inspection could affect inspection performance.

| | |
|---|---|
| ⚠ **CAUTION** | The Sensor alone will operate properly with input voltage of 10–30V dc; however, if a light source is powered by the Sensor, input voltage must be 24V dc ± 10%. |

## Installing the Lens

**Banner Lens Models LCF08, LCF12, and LCF16:** Remove any protective caps from the lens. Turn the metal lens base clockwise to thread the lens onto the Sensor. The plastic lens shroud is used for focusing; do not turn it when installing the lens. See Lens Focusing Ring and Lock Screws (in Section 4, Getting Started) on page 29 for details on focusing and locking the lens.

NOTE: Any C-mount lens may by used with PresencePLUS P4 Sensors. For non-Banner lenses, follow the lens manufacturer's unpacking and installation instructions.

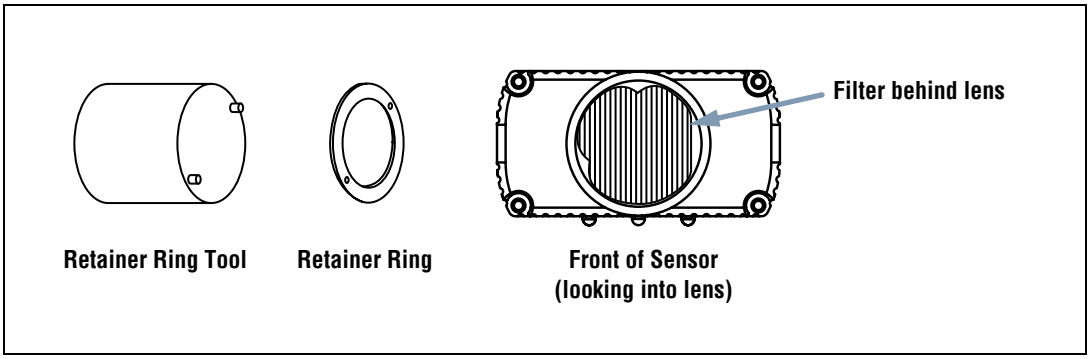



***Installing the Lens***

## Installing Lens Filters

The following apply to Banner filters designed to fit Banner-supplied lenses.

Colored, infrared, and polarized lens filters can be used. The filter fits behind the lens and is held in place with a retainer ring. Use the retainer ring tool that is supplied with the filter to add or remove a filter.




***Installing a Lens Filter***

# Sensor Connections

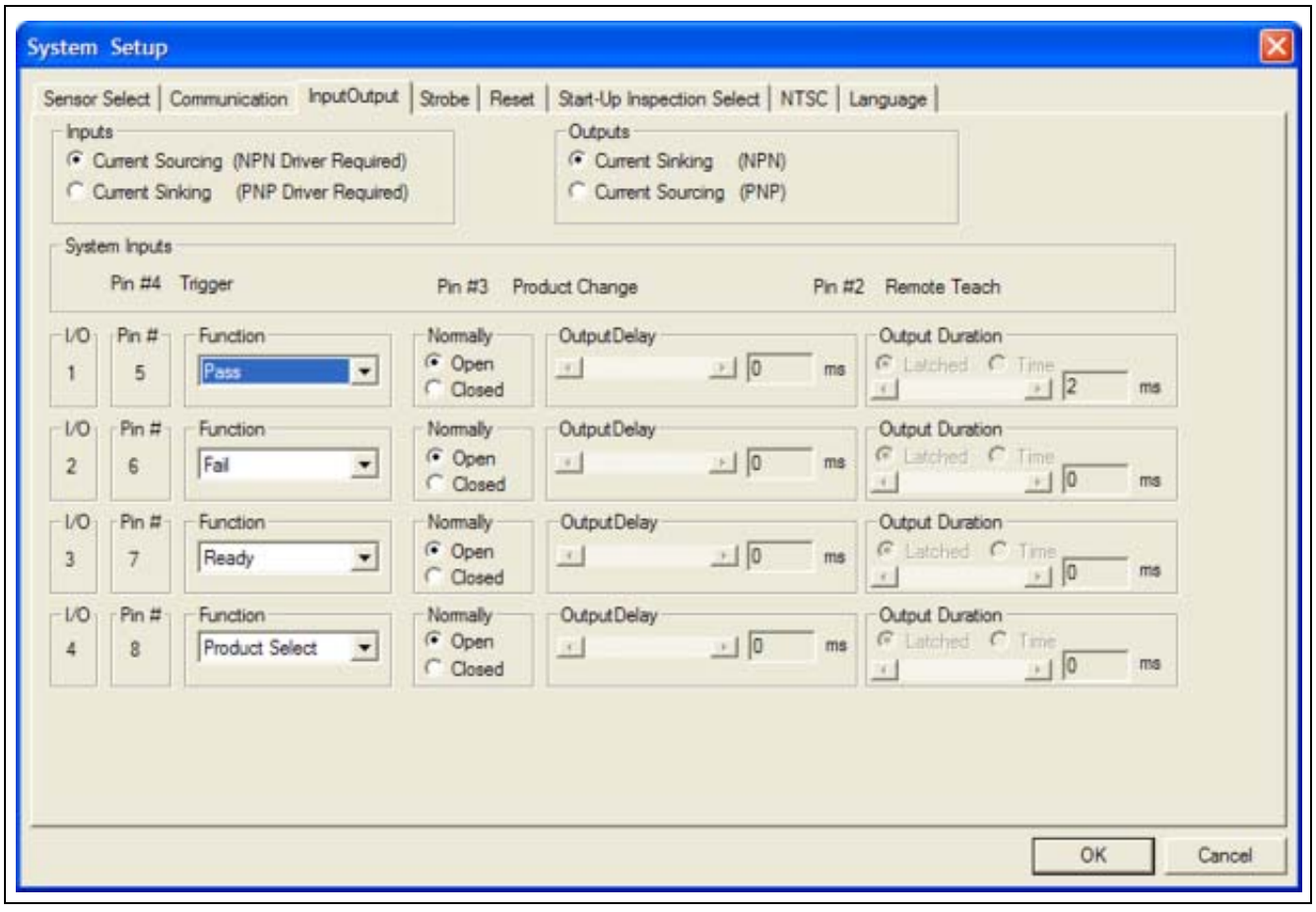
## Supply Voltage (Brown and Blue Wires), Pins 12 and 13

The Sensor requires a 10 to 30V dc power supply with 500 mA maximum current.

| | |
|---|---|
| **⚠ CAUTION** | The Sensor alone will operate properly with input voltage of 10-30V dc; however, if a light source is powered by the Sensor, input voltage must be 24V dc ± 10%. |

## Electrical Selection

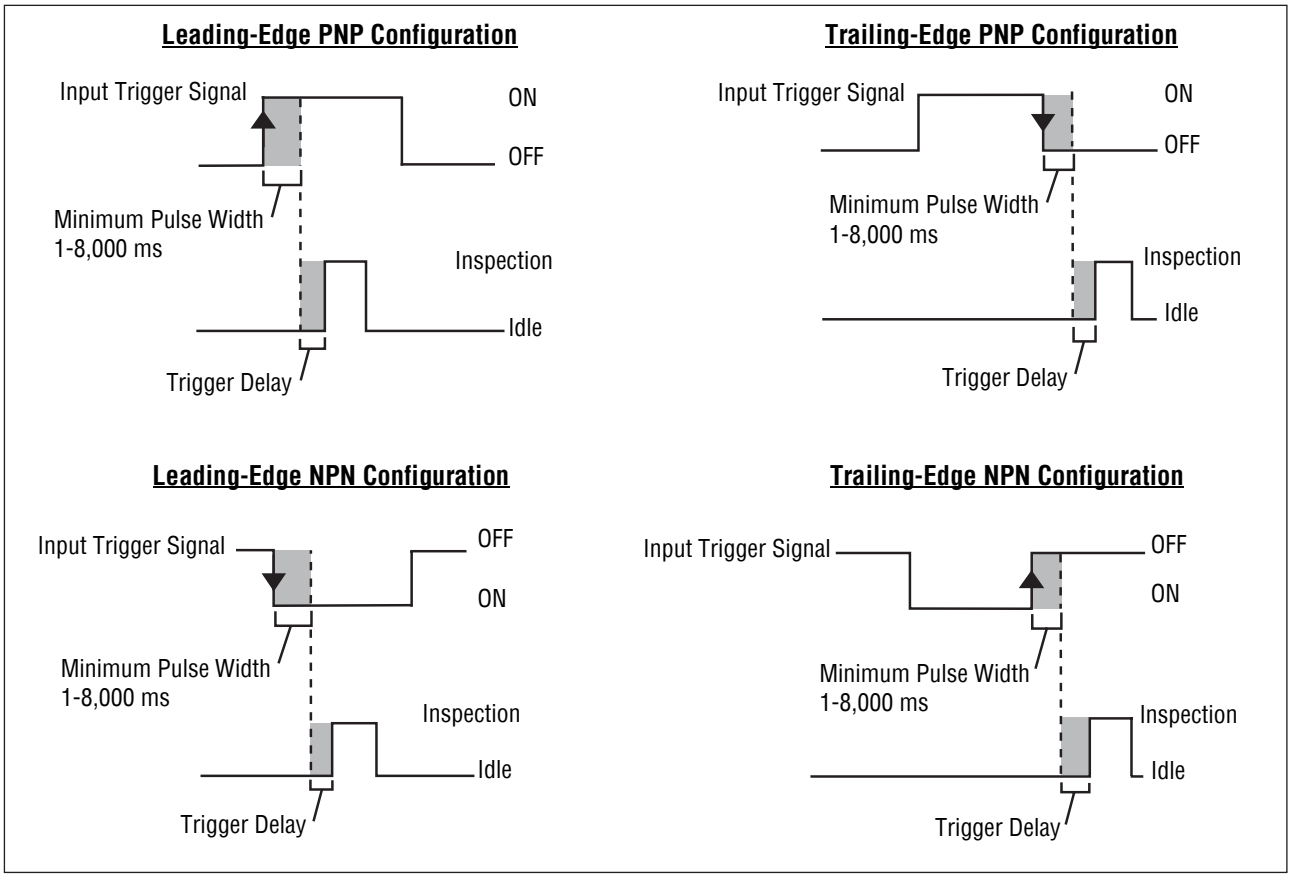
The P4 inputs (Trigger, Product Change, Remote Teach, and Discrete) and outputs can be configured for either NPN (current sourcing) or PNP (current sinking). This selection is made in the System Setup window on the **InputOutput** tab, shown below. Once NPN or PNP is selected, all inputs/outputs are either NPN or PNP.




***System Setup Window InputOutput Tab***

## Trigger (Pink Wire), Pin 4

- Input from an external triggering device is needed to signal the Sensor to acquire images.
- The Sensor can be set to respond to either the leading or trailing edge of the trigger pulse.
- Trigger pulse width can be set from 1 millisecond to 8 seconds. The default is 1 millisecond.
- Trigger modes:
  - Input current sinking mode (external PNP driver)
  - Input current sourcing mode (external NPN driver)




***PNP and NPN Leading-Edge and Trailing-Edge Trigger Inputs***

## Strobe Out

Strobe Out is Pin 4 of the light connector. When Strobe Out is enabled, the Sensor generates a strobed output signal upon receiving a valid trigger. The type of signal may be configured as shown below:

### Level (default: Active High)

**Active High:** Use if the light is enabled at 5V

**Active Low:** Use if the light is enabled at 0V

### Strobe Width (default: Time Duration)

**ON:** ON continuously

**OFF:** OFF continuously

**Exposure:** Active signal during the exposure time

**Time Duration:** Strobe is active upon a valid trigger, with length set from 1 to 10,000 ms

### Electrical Specifications of Strobe

**High:** 4V min. at 100 mA max.

**Low:** 0.5V max. at 100 microamps max.

## RS-232, Pins 1, 9, 10, and 11

The RS-232 port is used to export runtime information in ASCII format. For information on how to configure the serial connection, see Section 8, Exporting with the Communication Tool beginning on page 107 and Section 12, System Setup beginning on page 135.

| | | |
|---|---|---|
| Sensor Cable | to | PC Serial Port |
| Pin 1 (yellow wire), transmit data | to | Pin 2, receive data |
| Pin 9 (violet wire), receive data | to | Pin 3, transmit data |
| Pin 10 (green wire), signal ground | to | Pin 5, signal ground |
| Pin 11 (blue wire), dc common | to | Pin 5, signal ground |

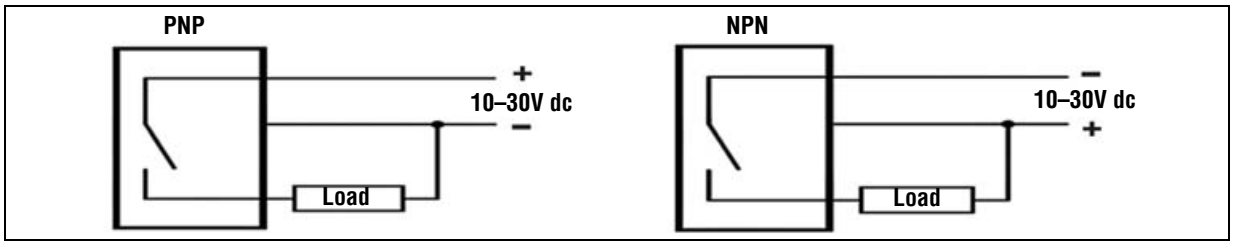
## Programmable I/O, Pins 5 through 8

The Sensor provides four discrete programmable I/O connections as listed in the table below. Each I/O type can be configured as follows:

- Input current sinking mode (external PNP driver, default) or input current sourcing mode (external NPN driver), and
- Output current sinking mode (NPN) or output current sourcing mode (PNP).

| | |
|---|---|
| Pin 5 (Black Wire) | I/O #1 |
| Pin 6 (Red Wire) | I/O #2 |
| Pin 7 (White Wire) | I/O #3 |
| Pin 8 (Light Blue Wire) | I/O #4 |

Typical PNP and NPN connections are shown below. See also the Programmable Input and Output Specifications table below.




***Programmable Input and Output Specifications***

| Programmable Input Specifications | Current Sinking (NPN) | Current Sourcing (PNP) |
|---|---|---|
| ON | < 2V at 1 mA max. | > 8V at –7.5 mA max. |
| OFF-State Voltage | > 10V at 4 mA max. | < 2V at –7.5 mA max. |
| **Programmable Output Specifications (150 mA Max. Each Output)** | **Current Sinking (NPN)** | **Current Sourcing (PNP)** |
| ON | < 2V at 1 mA max. | > 8V at –7.5 mA max. |
| OFF-State Voltage | > 10V at 4 mA max. | < 2V at –7.5 mA max. |

## Product Change (Orange Wire), Pin 3

The Product Change input is used in conjunction with one of the four I/O points programmed as a Product Select/Change line. The inspection loaded will be executed upon receiving a valid trigger.

- The Product Change input responds to the leading edge transition of a pulse greater than 1 millisecond.
- The Product Select input is pulsed to correspond to a program location. For example, five pulses will load program #5.

See Product Change and Product Select Timing on page 18.

***Product Change Specifications***

| State | Current Sinking (NPN) | Current Sourcing (PNP) |
|---|---|---|
| ON | < 2V at 1 mA max. | > 8V at –7.5 mA max. |
| OFF | > 10V at 4 mA max. | < 2V at –7.5 mA max. |

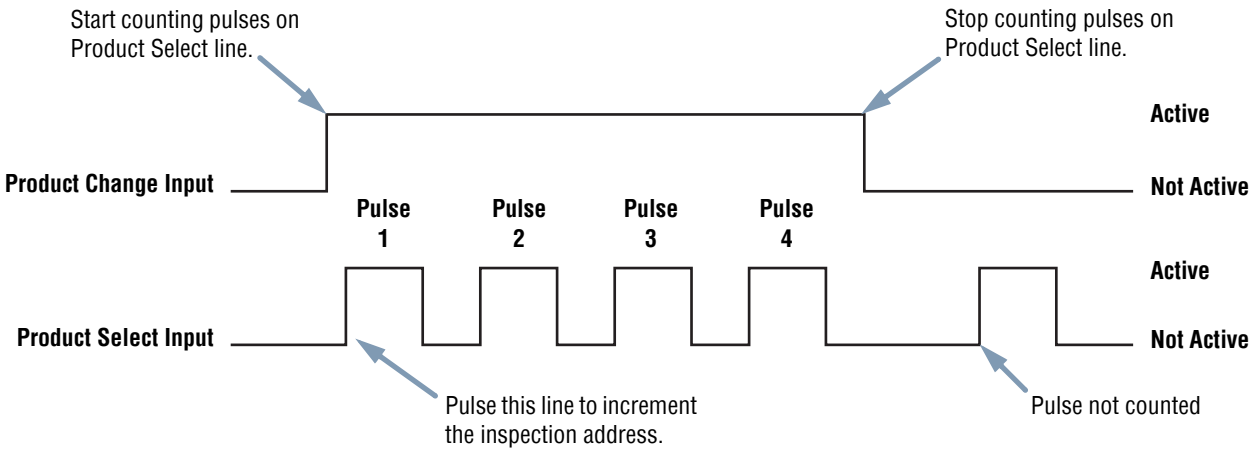
One of the four I/O (See Programmable I/O, Pins 5 through 8 on page 16) must be programmed as Product Select if this option is to be used.

***Product Select Input Specifications***

| State | Current Sinking (NPN) | Current Sourcing (PNP) |
|---|---|---|
| ON | < 2V at 1 mA max. | > 8V at –7.5 mA max. |
| OFF | > 10V at 4 mA max. | < 2V at –7.5 mA max. |

## Product Change and Product Select Timing

The Product Change line signals the Sensor to stop what it is doing and begin counting pulses on the Product Select line. The number of pulses indicates to the Sensor the inspection address at which to begin executing the inspection. The only pulses counted are those that occur when the Product Change input is active. As shown in the diagram below, the Product Select input pulse that occurs when the Product Change input is not active is NOT counted.




NOTES:

- The minimum pulse width on Product Select is 1 millisecond active and 1 millisecond inactive.
- In this example, the Sensor will stop executing the inspection it is currently running, go to address number four (because there are four pulses), load the inspection at location four, enter Run mode, and execute the inspection on the next valid trigger.
- If the Sensor is in Run mode, the Product Change line should be activated only when the Sensor is Ready (Green Ready LED is ON). If the Product Change line is activated when the Sensor is in Run mode but performing an inspection (not Ready), the current inspection will be aborted, and the Sensor will proceed to load the inspection at the indicated address.
- If the Product Change line is activated when the Sensor is not in Run mode (Setup mode, for example), then the Sensor will go to the address indicated (address number four in this case) and begin executing.
- The maximum number of pulses is limited by the number of inspections possible on the Sensor.

***Product Change and Product Select Timing Diagram***

# Software Installation

The PresencePLUS P4 software CD provides the PresencePLUS P4 software and documentation.

## Host Computer Requirements

PresencePLUS P4 software requires the following host computer capabilities:

- 486 microprocessor or faster, running Microsoft Windows ME, NT, 2000, or XP operating system
- 16 MB RAM minimum, 24 MB recommended
- 15 MB available hard disk space
- 1024 x 768 or greater display screen resolution

## Installing the Program

1. Close all active programs.
2. Uninstall previous installations of PresencePLUS (see below).
3. Insert the PresencePLUS P4 CD into the CD ROM drive. The CD will auto-start.
   NOTE: If the install screen does not appear:
   a) Double-click on the **My Computer** icon.
   b) Double-click on **CD Drive** in the list that appears.
   c) Double-click on the **PresencePLUS** autorun file for your PresencePLUS P4 Model.
4. When the Install screen appears, click **PresencePLUS PC Software**.
5. Follow the instructions on the screen.
6. Reboot the PC.

## Uninstalling the Program

1. Close the PresencePLUS P4 program.
2. In the task bar at the bottom of the screen, click **Start**.
3. Choose **Settings** > **Control Panel**.
4. Double-click **Add/Remove Programs**.
5. Select **PresencePLUS P4** from the list of programs.
6. Click **Add/Remove**, and follow the instructions.

# Startup and Troubleshooting

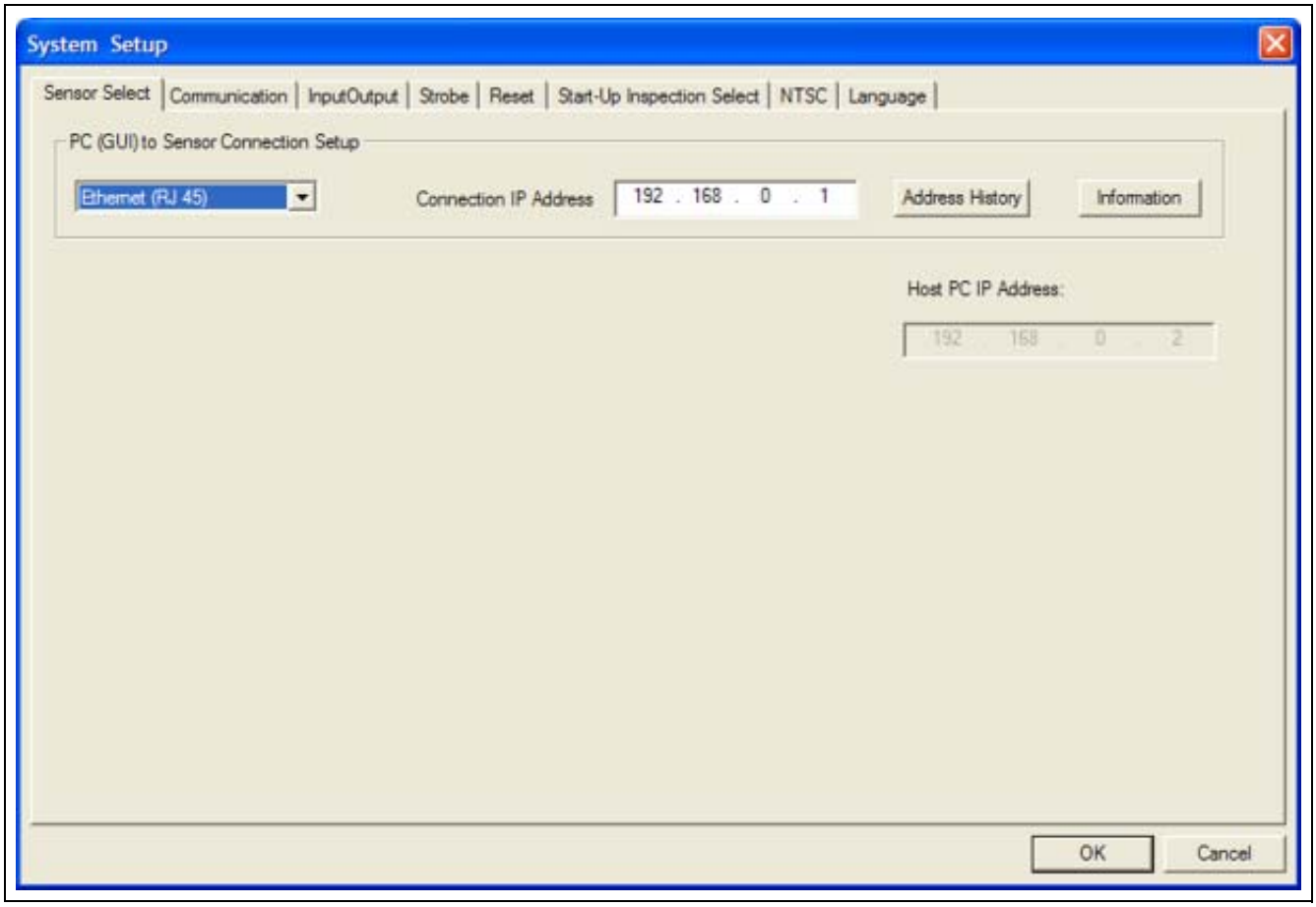
This section explains how to verify connections, start the PresencePLUS P4 program, and troubleshoot possible problems.

## System Startup

1) **Verify cable connections.**
   - The Sensor is connected to a PC with an Ethernet crossover cable or serial cable.
   - The monitor (if one is being used) is connected to the video port on the Sensor.
2) **Verify electrical connections.**
   - +V is connected to Pin 12, brown wire, 10–30V dc (24V dc ± 10% if a light is powered by the Sensor).
   - –V is connected to Pin 11, blue wire (dc common).
   - The trigger device is connected to Pin 4 (pink wire, Trigger In).
   - Any additional connections are made as required.
3) **Verify power.**

   Ensure that the Sensor is powered by 10-30V dc (24V dc ± 10% if a light is powered by the Sensor).
4) **Verify PC configuration.**
   - Ethernet connection: IP address of PC is 192.168.0.2
   - Serial connection: A dial-up network has been established, and the network is a point-to-point protocol (PPP).
5) **Power up the Sensor.**

   Verify that the Red Error LED light turns OFF (during power-up, all Sensor LEDs turn ON for 15 to 20 seconds). After the Red Error LED turns OFF, verify that the Green Power LED is flashing.
6) **Launch the software.**
   - Click **Start > PresencePLUS** to start the program.
   - If PresencePLUS P4 has a different IP address than the default address (192.168.0.1), or if it is connected through a serial connection, the message shown below will appear.
   - Click **Yes** to access the Sensor Select Tab (shown on page 21).




***Sensor Select Tab***

- Change the connection setup as follows:

  **Ethernet Connection**:

  a) Select **Ethernet (RJ 45)** in the pull-down menu.

  b) Change the IP address to the address of the Sensor.

  c) Click **OK**.

  **Serial Connection**:

  a) Select **PC Serial** in the pull-down menu.

  b) Click **OK**.

  NOTE: A serial connection requires changes to the Sensor and an established dial-up network. See the PresencePLUS P4 Serial Connection Procedures document (on the software CD) for instructions on setting up a dial-up network.

**7) Configure the discrete I/O, create an inspection, and begin running inspections.**

NOTE: Initially, all discrete I/O's are configured as inputs. If you create an inspection before configuring the discrete I/O, no outputs will be available in the Test tool. For configuration information, see InputOutput Tab (in Section 12, System Setup) on page 140.

# Troubleshooting Error Messages

**"Sensor not found on IP 192.168.0.1. Do you want to try another IP address?"**

1. Check the power. Is the Green Power LED ON?

   **Yes**: Go to step 2.

   **No**: Check the power connection. Verify that the power source is 10–30V dc and 500 mA maximum.

2. For an **Ethernet** connection:

   a) Is the yellow LED indicator integrated with the RJ-45 port ON?

   **Yes**: Go to step b.

   **No**: Verify that the cable is the correct type. Direct connection to a PC requires a crossover adapter or a crossover Ethernet cable. Connection to a network requires a straight Ethernet cable.

   b) Does the error message display the IP address 192.168.0.1?

   **Yes**: Go to step c.

   **No**: Change the IP address in the software to 192.168.0.1 and retry.

   c) Click the **Yes** button. If the Sensor is found on another IP address, the following message will appear:

   **Yes**: Click **Yes**, and start working with the software.

   **No**: Click **No**, and in the **IP Address** box, change the IP address to the IP address of the Sensor (default is 192.168.0.1), and click the **OK** button.

   d) Does the software find the Sensor?

   **Yes**: Start working with the software.

   **No**: Go to step e.

   e) Verify that the IP address of the PC is configured to work with PresencePLUS P4.

   Is the PC configured as follows?

   **IP address** = 192.168.0.2

   **Subnet mask** = 255.255.255.0

   **Yes:** Contact a Banner Applications Engineer. See Factory Support (in Section 1, Product Support and Maintenance) on page 1.

   **No:** Change the IP address and subnet mask to match the IP address and subnet mask listed above.

3. For a **Serial** connection:
   a) Is the serial port configured for point-to-point protocol (PPP)?
      **Yes**: Go to step b.
      **No**: Use the PresencePLUS P4 Serial Connection Procedures document to guide you through the process of enabling PPP in the serial port through the boot menu.
   b) Was the dial-up network running before you installed the software?
      **Yes**: Go to step c.
      **No**: Start the dial-up network session with PresencePLUS P4. Use the PresencePLUS P4 Serial Connection Procedures document to guide you through the process of creating a dial-up network.
   c) Choose **Serial Connection** in the Sensor Select screen.

NOTE: A list of error codes and potential causes and solutions are available under Help/About on the PresencePLUS P4 software CD.

### "Failed to capture a full-resolution image. Please try again."

See the Troubleshooting Table on page 24.

### "Failed to capture a full-resolution image."

See the Troubleshooting Table on page 24.

# Troubleshooting Table

This table contains solutions to the most common problems in using the PresencePLUS P4 program. For further assistance, contact Banner.

| Problem | Cause / Solution |
|---|---|
| - Green Power LED on Sensor is not ON.<br>- Interface cannot connect to Sensor.<br>- No image on monitor. | **Sensor not getting enough power**<br>- Verify that the power supply is 10–30V dc with 500 mA maximum current.<br>- Check the connection to the power supply. |
| - No image on PC or monitor.<br>- Green Ready LED on Sensor is OFF.<br>- The software seems to be working correctly, but the image is missing. | **Sensor not receiving triggers**<br>- Ensure that the Sensor is receiving triggers signals. The trigger mode can be Continuous, External, or Manual.<br>- If the connections are secure, call a Banner Applications Engineer.* |
| - Error message, “Failed to capture a full-resolution image. Please try again.”<br>- Image is frozen on PC and monitor.<br>- Green Ready LED on Sensor is OFF. | **Software restart needed or loose connections**<br>- Restart the PresencePLUS P4 software.<br>- If a software restart does not correct the problem and the connections are secure, call a Banner Applications Engineer.* |
| - Error message, “Failed to capture full-resolution image.”<br>- Image is frozen on PC, but image on monitor properly updates.<br>- Indicator lights on RJ-45 port are OFF. | **Ethernet connection lost**<br>- Reconnect the cable.<br>- Check the cable for breaks, then power down and back up.<br>- Replace the cable.<br>- Attempt to close and reopen the PresencePLUS P4 software.<br>- If still not resolved, call a Banner Applications Engineer.* |
| - Focus number does not update.<br>- QuickStart fails.<br>- Errors when saving inspections to the Sensor. | **FTP communications blocked**<br>- In the **File** pull-down menu in Internet Explorer, uncheck the **Work Offline** option. |
| - Error code is displayed on PC. | - A list of error codes and potential causes and solutions are available under Help/About on the PresencePLUS P4 software CD. |
| * See Factory Support (in Section 1, Product Support and Maintenance) on page 1. | |

# 4. Getting Started

This section presents typical approaches to setting up and running inspections.

Typical Setup and Startup Sequence . . . . . 26
Starting Up the Software . . . . . 26
Setting Up Hardware Parameters . . . . . 28
Building an Inspection . . . . . 28
Navigating in PresencePLUS P4 . . . . . 30
Exiting PresencePLUS P4 . . . . . 30
Software Overview . . . . . 31
- Main Menu Toolbar . . . . . 32
- Image Window . . . . . 33
- Navigation/Results Window . . . . . 33
- Configuration Window . . . . . 35
- Status Window . . . . . 36

# Typical Setup and Startup Sequence

The following subsections proceed through a typical Sensor setup and startup sequence:

1. Connect and power up the hardware.
2. Start up the software.
3. Set up hardware parameters.
4. Build and run an inspection.

For complete installation information, see Section 3, Installation beginning on page 9 or the Installation section of the Help files on the PresencePLUS P4 software CD. For component and cabling illustrations, see Components and Connections (in Section 2, System Overview) on page 7.

# Starting Up the Software

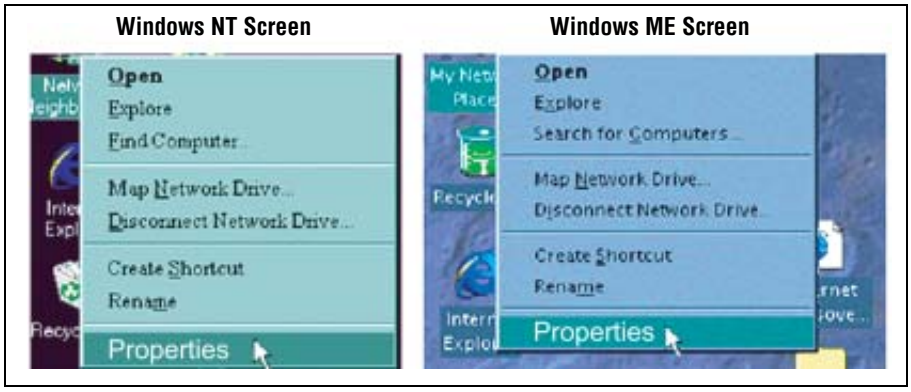
1. Power up the PC.
2. Install the software if it has not been installed. The Installation screen of a typical PresencePLUS P4 software CD is shown below.

***PresencePLUS Software Installation Screen***

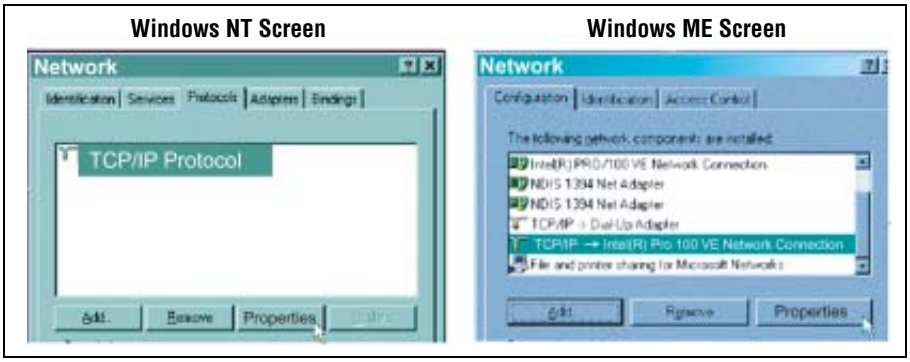
3. Configure the IP address as follows:

   NOTE: The following screens depict Windows NT and Windows ME. Other Windows versions may vary.

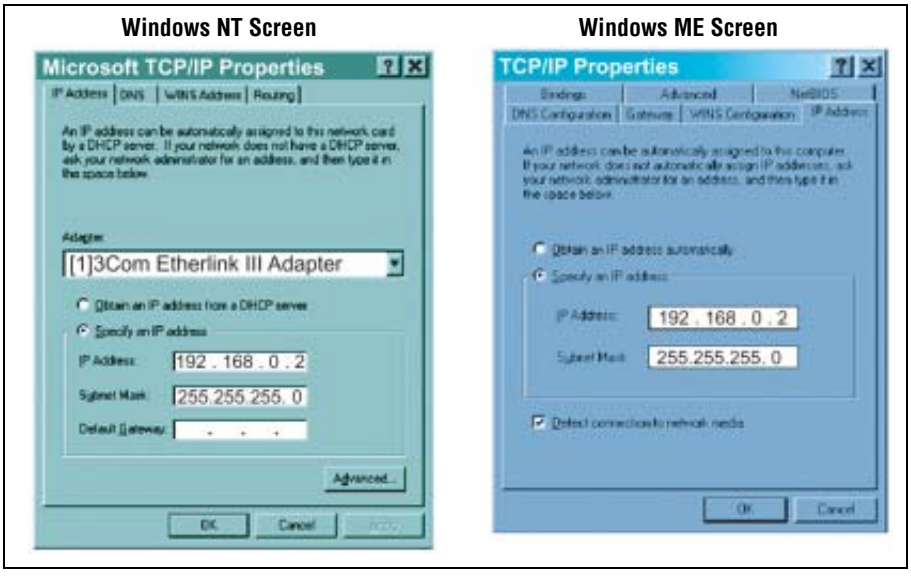
a) Open the **Network Properties** on the PC (right-click the **Network Neighborhood** icon).




b) Open the **TCP/IP Properties**.




c) Change the IP address to 192.168.0.2. Change the subnet mask to 255.255.255.0.




d) If prompted, reboot the PC.

4. Start the software by double-clicking the program icon, or choosing

in the Programs menu.

   Upon startup, the program detects whether a Sensor is connected and displays either the Setup screen or the Run screen.

# Setting Up Hardware Parameters

If the Sensor is being run for the first time, or if changes have been made to the hardware, then hardware parameters may need to be set or modified:

1. Click on **System** in the Main Menu toolbar.
2. Configure the Trigger parameter according to the trigger device being used.
   For this example, the QS18V6ND (NPN output) is the trigger device, so NPN is selected.
3. Configure the four discrete inputs/outputs.
4. If a strobed light source is being triggered by the Sensor, set the strobe trigger options.
5. If the Product Select line is being used, configure the Product Select and Product Change lines.
6. Click on **Setup** in the Main Menu toolbar, select the **Trigger** tab, and configure the remaining parameters:
   - Edge type
   - Minimum pulse width
   - Trigger delay

# Building an Inspection

The automatic screen sequence starts with the Setup screen, which results from the first button (**Setup**) in the Main Menu toolbar. Subsequent screens are shown below in the Main Menu toolbar layout.

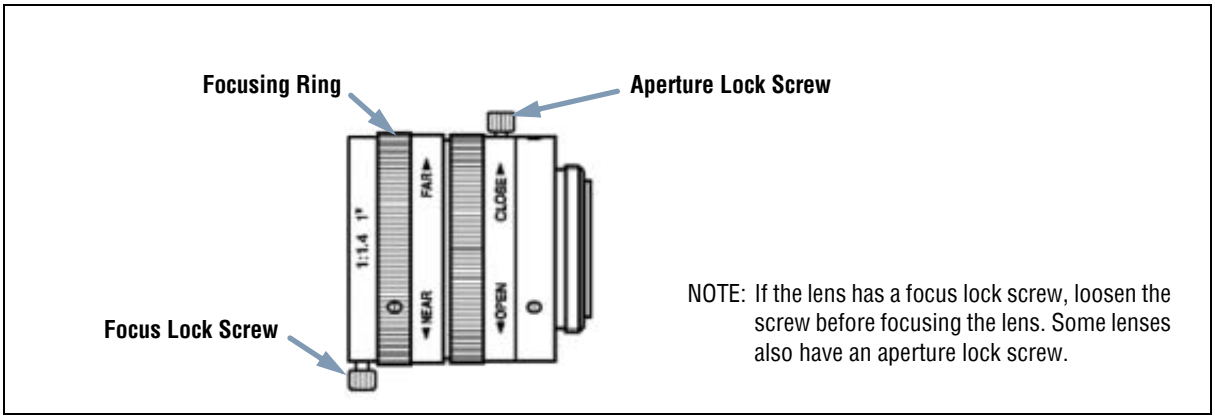
***Main Menu Toolbar Buttons in Left-to-Right Task Order***

Click on the **Setup**, **Tools**, **Teach**, and **Run** buttons to advance to each screen.

Follow these basic steps to build and run a new inspection:

1. **Setup screen:**
   a) Set up the Sensor, lens, and lighting.
   b) Choose trigger option **Continuous** for a live image.
   c) Click **Auto Exposure** to adjust the image brightness.
   d) Focus the lens by turning the lens focusing ring (shown below) until the focus value is maximized. See Focusing the Lens (in Section 5, Setup) on page 43.

.


Focusing Ring
Aperture Lock Screw
Focus Lock Screw
1:1.4 1'
FAR
NEAR
CLOSE
OPEN
NOTE: If the lens has a focus lock screw, loosen the screw before focusing the lens. Some lenses also have an aperture lock screw.

***Lens Focusing Ring and Lock Screws***

   e) When the desired image is shown, click **Next** to proceed to the Tools screen.

2. **Tools screen:**
   Tools can be built from scratch or added from a previous inspection file saved on the PC or Sensor. To add a Vision tool, click the **Tools** button. To remove a tool, click the ✕ in the lower-left corner of the screen while that tool is selected.
   a) Add Location tool(s) to find the target and to adjust the Regions of Interest (ROI) for translational and rotational changes.
   b) **REQUIRED:** Add Vision tool(s) to inspect the part.
   c) Add Measure tool(s) to create distance measurements from points found.
   d) **REQUIRED:** Add Test tool(s) to set the Pass/Fail criteria (Vision and Measure tools are inputs to the Test tool).
   e) Click **Quick Teach** to automatically set all the selected parameters in the Test tool and to proceed to the Run screen, or click **Next** to proceed to the Teach screen and to teach a sample set of good products.
   NOTE: To keep parameters in a Test tool, skip Teach and go directly to Run.

3. **Teach screen:**
   The Teach screen automatically configures the parameters chosen in the Tools screen.
   a) Choose the sample size.
   b) Click **Start**.
   c) Trigger the Sensor with the external trigger device.
   d) Click **Stop**.
   e) Save the inspection file to one of the 12 memory locations on the Sensor.
   f) Click **Next** to proceed to the Run screen.

| TIP | Save a backup copy of the inspection to the host PC. |
|---|---|

4. **Run screen:**

   Select an inspection to run, and review the results of the inspection.

   - To select an inspection (in the **Select** tab), enable **Software Override**, and select the inspection file from the list of stored inspections on the Sensor.
   - Alternate method: Use **Hardware Input** to select an inspection via discrete inputs to the Sensor.

5. **Begin inspection:**

   To begin inspecting, click the **Start** button in the Run screen.

# Navigating in PresencePLUS P4

The application follows typical navigational sequences (example: Setup > Tools > Teach > Run) when **Next** is clicked to finish each step. Experienced users may prefer to work in some other sequence (Setup > Tools > Run, for example) by selecting the preferred destination from the Main Menu toolbar.

# Exiting PresencePLUS P4

Click the Close button ( ) in the upper-right corner of the screen. If the current inspection is not saved, the software will prompt the user to do so prior to exiting. See Section 14, Saving Inspections beginning on page 149.

# Software Overview

The Setup screen, shown below, provides the Main Menu.

**Image Toolbar**

Allows manipulation of the Image window properties and contents.

See Image Toolbar Buttons on page 33.

**Main Menu Toolbar**

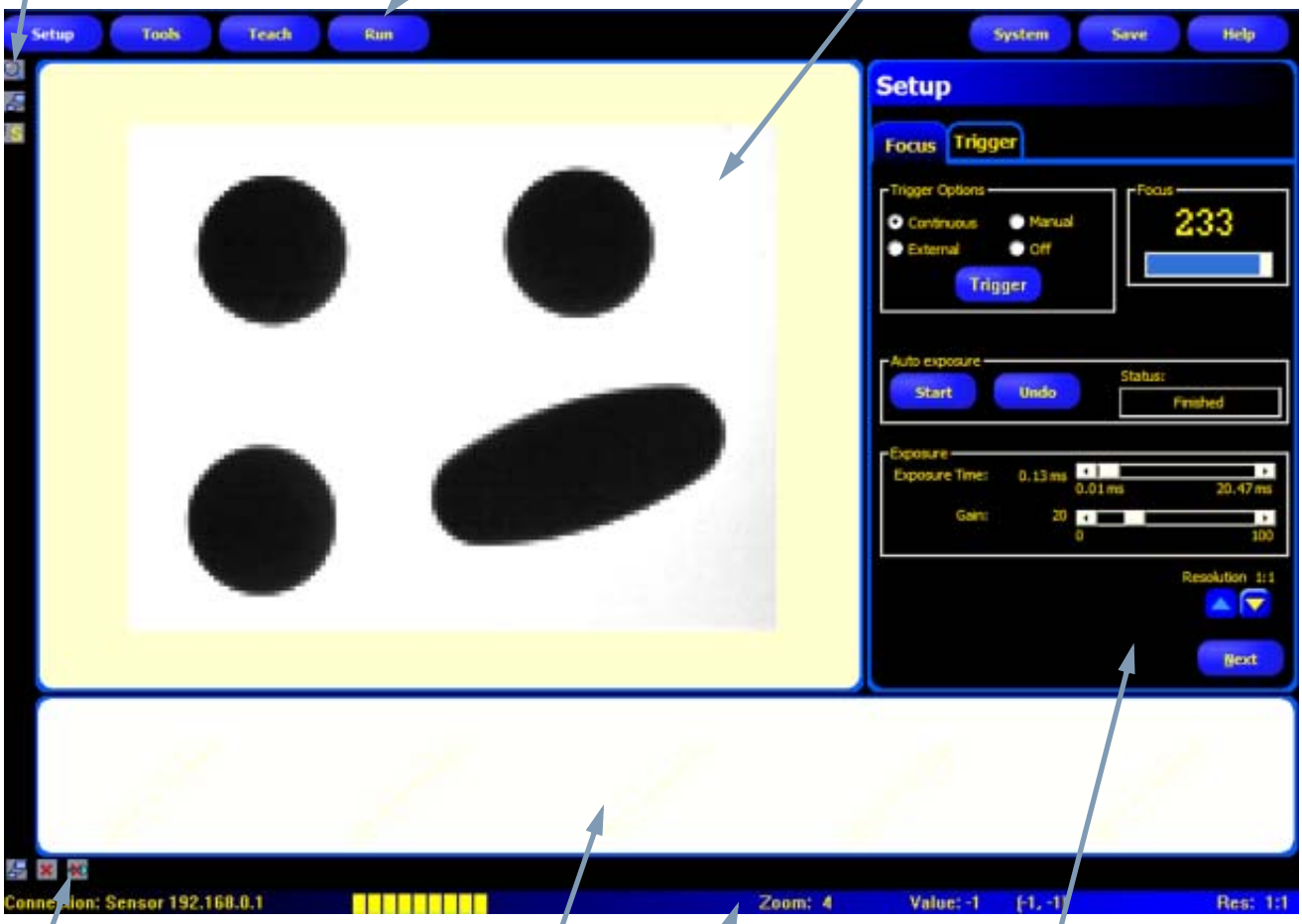
Arranged from left to right, steps through the inspection creation process.

See Main Menu Toolbar on page 32.

**Image Window**

Displays Sensor image or reference image for the current inspection. This window is updated after a trigger.

See Image Window on page 33.




**Navigation/Results Toolbar Buttons**

Selects the Navigation/Results window display and files.

See Navigation/Results Toolbar Buttons on page 34.

**Navigation/Results Window**

Displays navigation buttons or inspection results information.

See Navigation/Results Window on page 33.

**Status Window**

Displays feedback during Setup and Run.

See Status Window on page 36.

**Configuration Window**

Displays the currently selected options and Sensor settings.

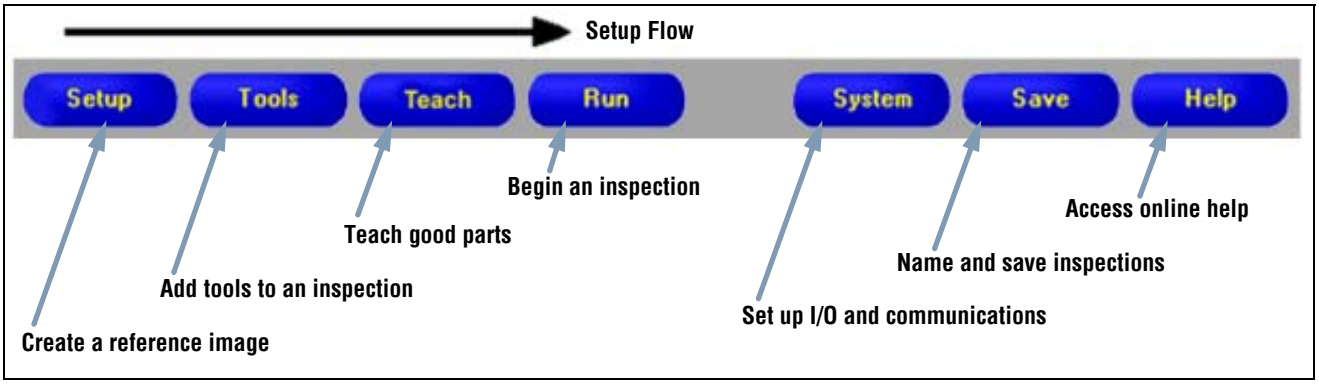
See Configuration Window on page 35.

***Setup Screen***

# Main Menu Toolbar

Use the Main Menu toolbar to navigate between the Sensor options. Proceeding from left to right, the buttons in the Main Menu toolbar step through the process of creating and controlling an inspection. Each button is explained in the illustration below and in the table that follows.

For more information about navigating through options, see Section 4, Getting Started beginning on page 25.




***Main Menu Toolbar Layout***

The following table describes the screen associated with each button in the Main Menu.

| Inspection Screens | |
|---|---|
| **Setup** | Set up the Sensor, lens, trigger, and lighting to acquire images. Create a reference image to be used later. |
| **Tools** | Add tools to an inspection. Build the tools from scratch, or load tools from a previous inspection file saved on the Sensor or on a PC. |
| **Teach** | Teach the Sensor good products. This screen automatically configures the parameters chosen in the Tools screen. |
| **Run** | Choose which inspection file the Sensor will capture, and view the results of the inspection. |
| **System-Wide Screens** | |
| **System** | Set up the discrete inputs and outputs and communication configuration. This screen also has the Sensor diagnostic tools. |
| **Save** | Name the current inspection files, and save them to the Sensor or a PC for future use. |
| **Help** | Call up the Help window or the About window. |

# Image Window

The Image window displays images acquired from the Sensor or the reference image that is set for the current inspection. The toolbar buttons in the Image window are explained in the illustration below.

NOTE: The reference image is used as a template for developing an inspection; it establishes initial values. The reference image also is used by Quick Teach.

See Quick Teach (in Section 6, Tools Screen) on page 54.

**Zoom**

Toggles between enabling and disabling Zoom control. When enabled, click on the Image window to zoom in, right-click to zoom out. This button is active when an image is displayed in the Image window.

**Expand Image**

Toggles the size of the Image window between maximum and minimum.

**Selected ROI / All ROIs**

Toggles between the currently selected ROI and all ( A ) ROIs.

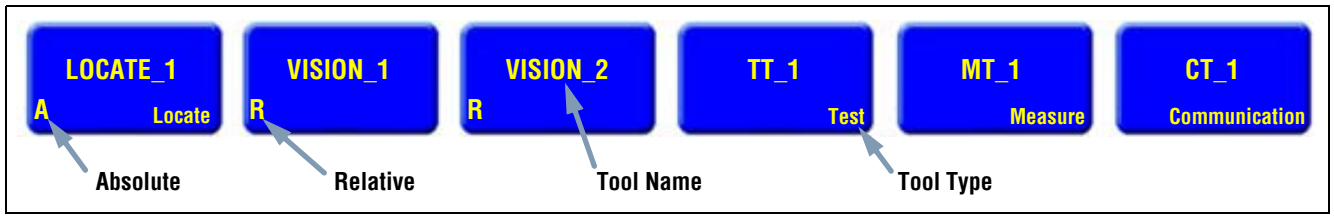
***Image Toolbar Buttons***

# Navigation/Results Window

The Navigation/Results window displays tool navigation buttons or inspection results files.

## Tool Navigation Buttons

Clicking on the **Tools** button in the Main Menu toolbar brings up the tool navigation buttons (shown below) in the Navigation/Results window. When setting up or using tools, click on any tool navigation button to get the corresponding tab in the Configuration window.




***Tool Navigation Buttons***

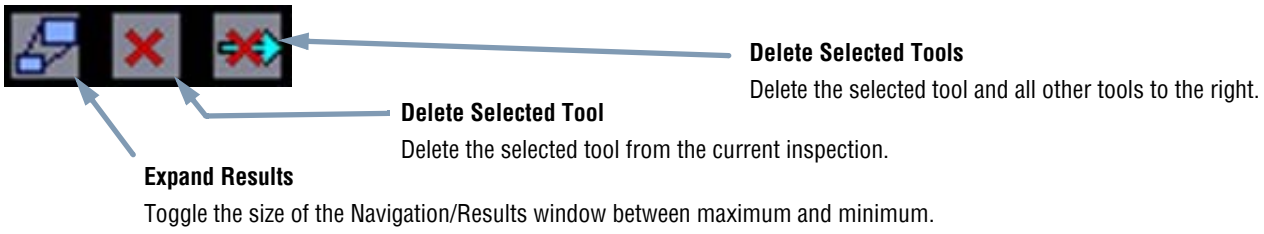
## Absolute and Relative Tools

The Location tool tracks parts in the Image window and the Vision tool that follows is relative. If the Vision tool precedes the Location tool, it will be absolute. Rules governing whether a tool is absolute or relative are as follows:

- The first Location tool is always absolute.
- All tools following a Location tool are relative to that tool.
- For a Vision tool to be absolute, it must be placed before any Location tools.

### Navigation/Results Toolbar Buttons

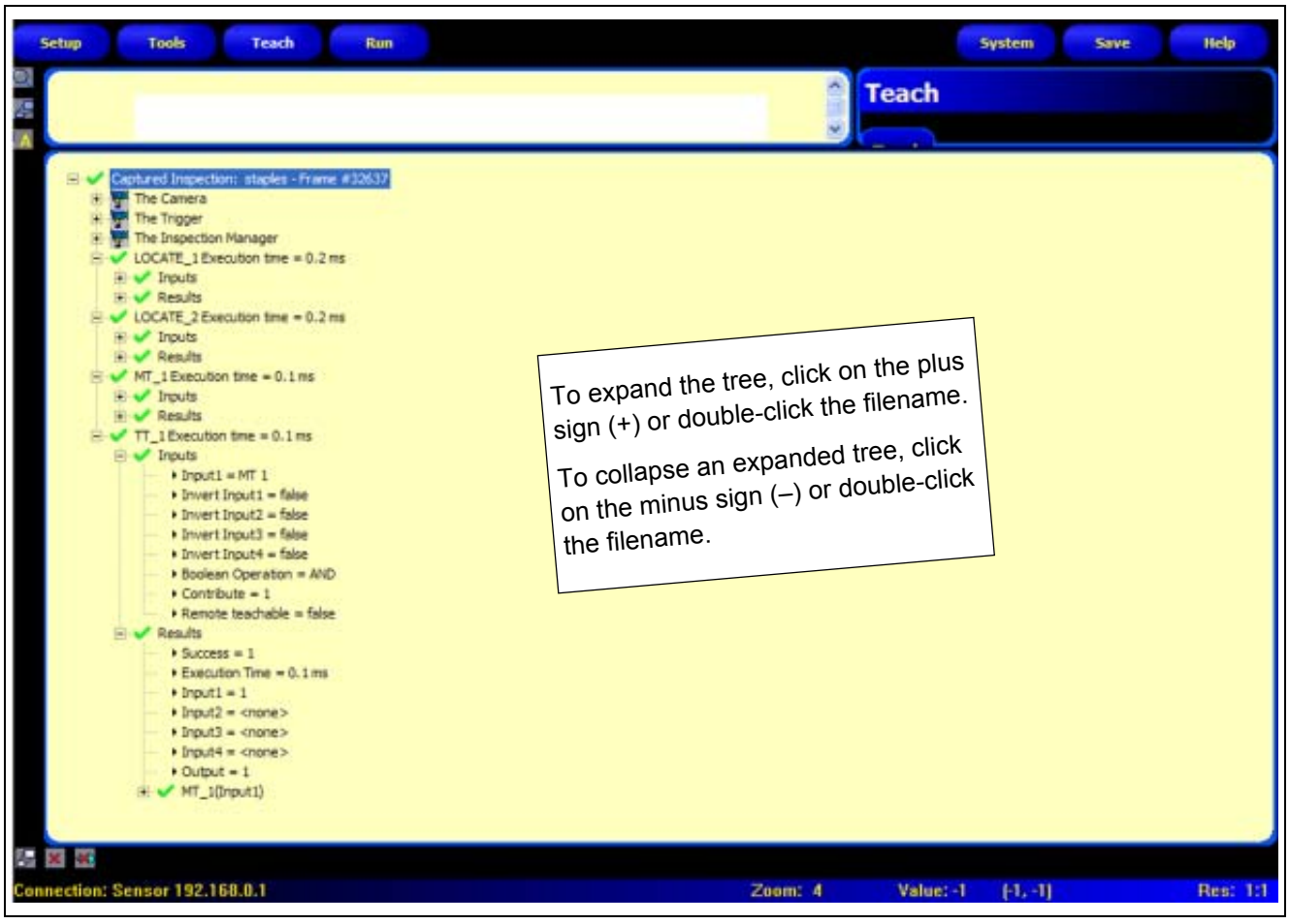
Using the Navigation/Results toolbar buttons, the Navigation/Results window size can be set, and tools can be deleted. The toolbar buttons are explained in the illustration below.


Delete Selected Tools
Delete the selected tool and all other tools to the right.
Delete Selected Tool
Delete the selected tool from the current inspection.
Expand Results
Toggle the size of the Navigation/Results window between maximum and minimum.

***Navigation/Results Toolbar Buttons***

### Expand Button

Clicking on the **Expand** button ( ) toggles the size of the Navigation/Results window to accommodate an expanded list of inspection results files, as shown below.

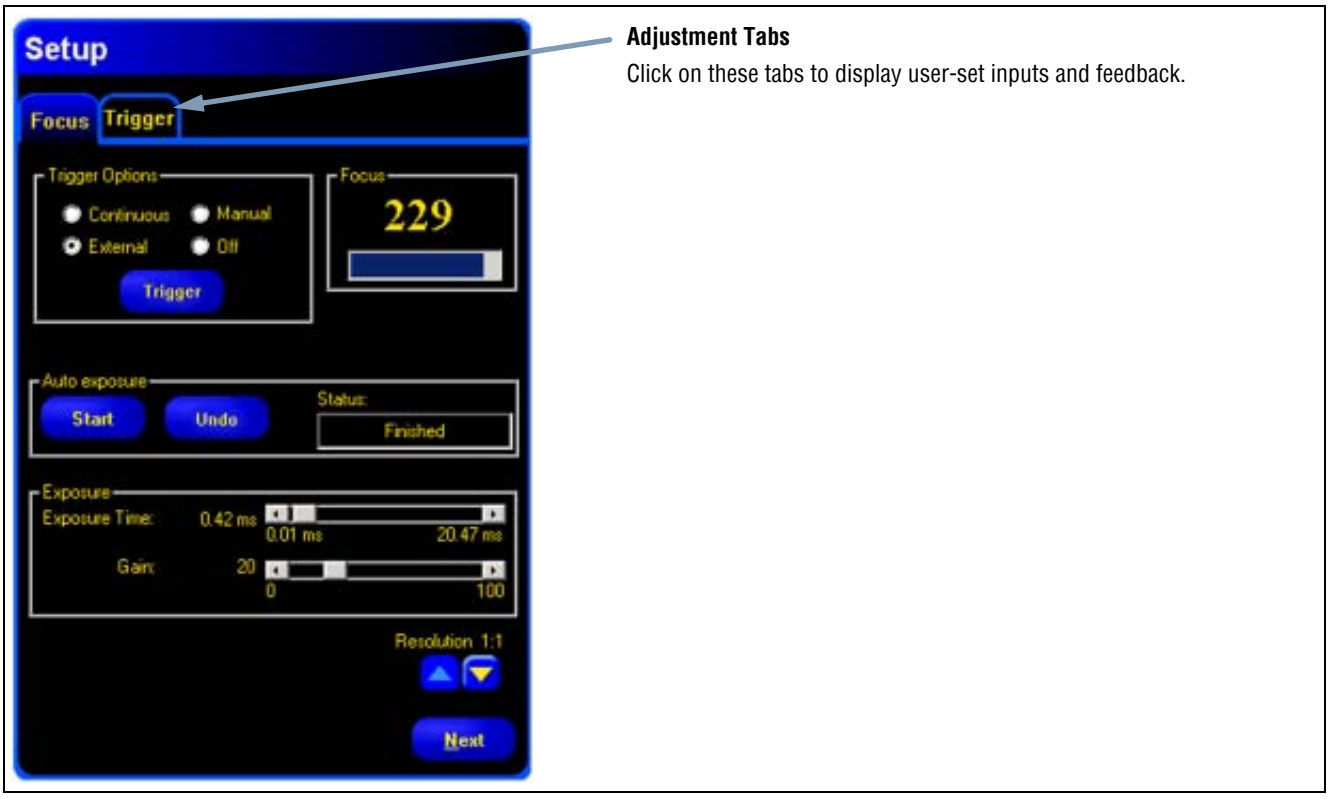



***Expanded Navigation/Results Window with Inspection Results Files***

## Configuration Window

The Configuration window displays the currently selected options with multiple tabs. Clicking the **Setup**, **Tools**, **Teach**, **Run**, **System**, **Save**, or **Help** buttons on the Main Menu toolbar (see Main Menu Toolbar on page 32) changes the contents of the Configuration window accordingly.

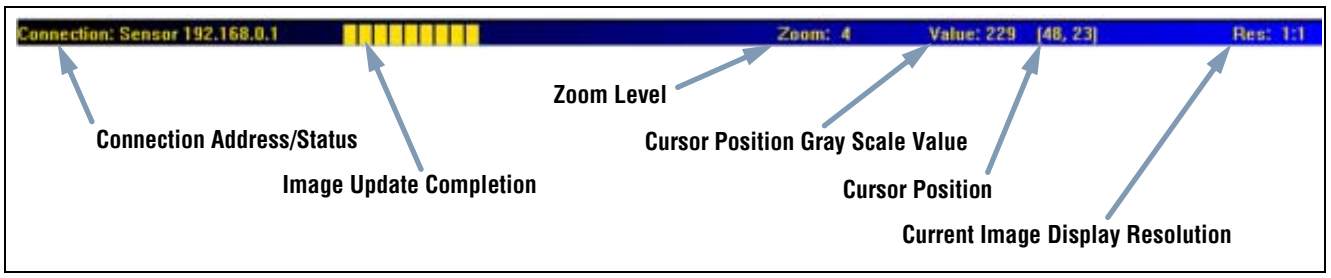
For more information about navigating through the Sensor options, see Software Overview on page 31.




***Configuration Window***

## Status Window

The Status window, shown below, provides the following Sensor feedback.




***Status Window Layout***

The following table provides descriptions of each region in the Status window:

***Status Window Regions***

| Region | Description |
|---|---|
| Connection Address/Status | Displays Sensor IP address when connection from Sensor to PC is satisfactory. |
| Image update completion | Progress bar shows relative image update completion when an image is being transferred from the Sensor to the PC. |
| Zoom level | Displays the selected zoom level of the image window. |
| Cursor position gray scale value | The 0-255 gray scale value of the pixel under the cursor. |
| Cursor position | Displays the x, y coordinates of the pixel under the cursor relative to the upper-left corner (origin, which is 0,0) of the Field of View (FOV). |
| Current image display resolution | Displays the user-specified value, which can be from 1:1 to 64:1. |

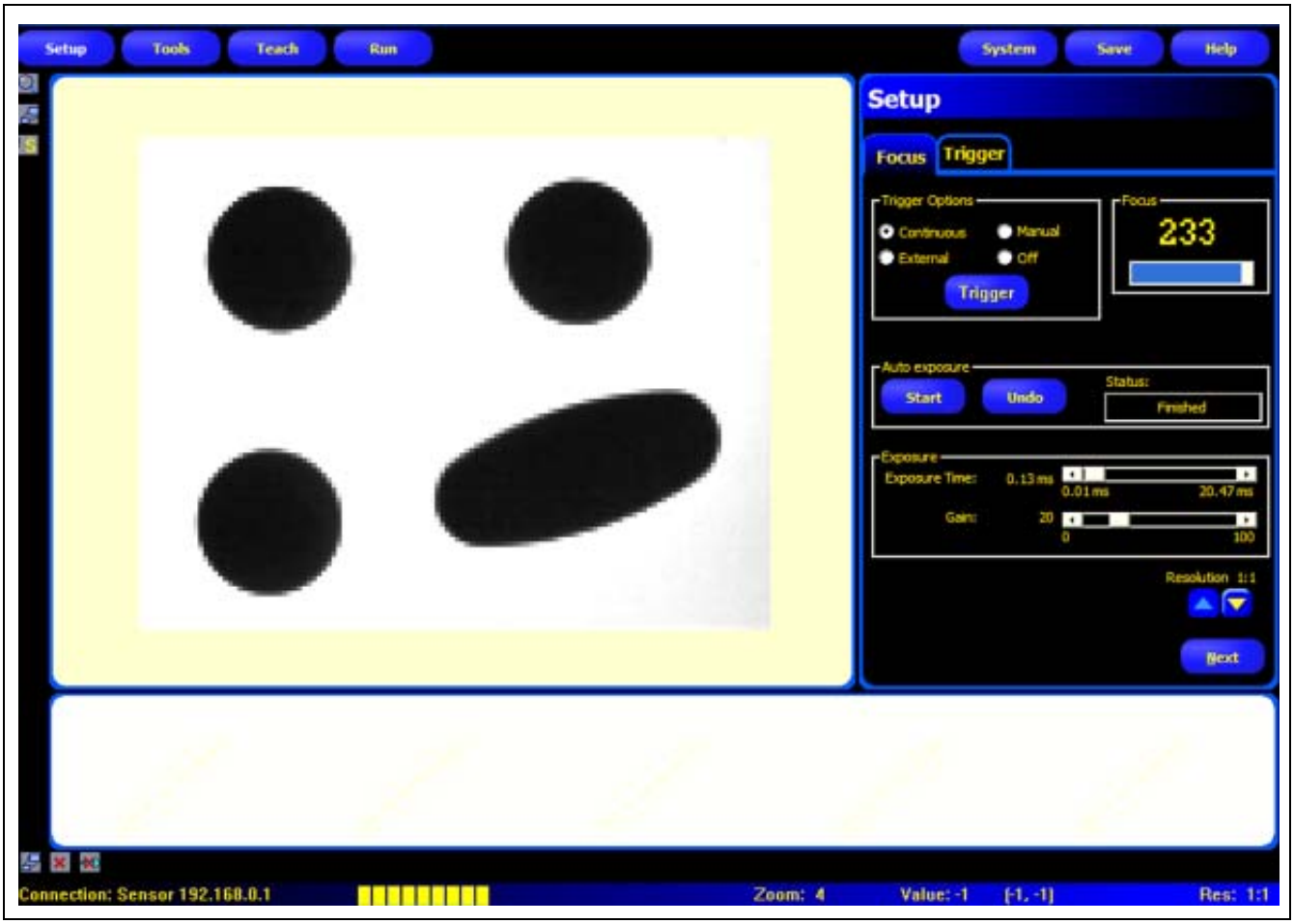
# 5. Setup

This section explains how to capture a reference image and set trigger options.

Setup Screen . . . . . 38
Capturing a Reference Image . . . . . 39
Focus Tab . . . . . 39
Choosing a Trigger Type . . . . . 40
Setting Exposure and Gain . . . . . 40
Exposure Time Considerations . . . . . 42
Focusing the Lens . . . . . 43
Setting Trigger Parameters . . . . . 44

# Setup Screen

On initial startup, the Sensor displays the Setup screen, which is shown below. To return to the Setup screen after passing it, click the **Setup** button in the Main Menu toolbar.




***Setup Screen***

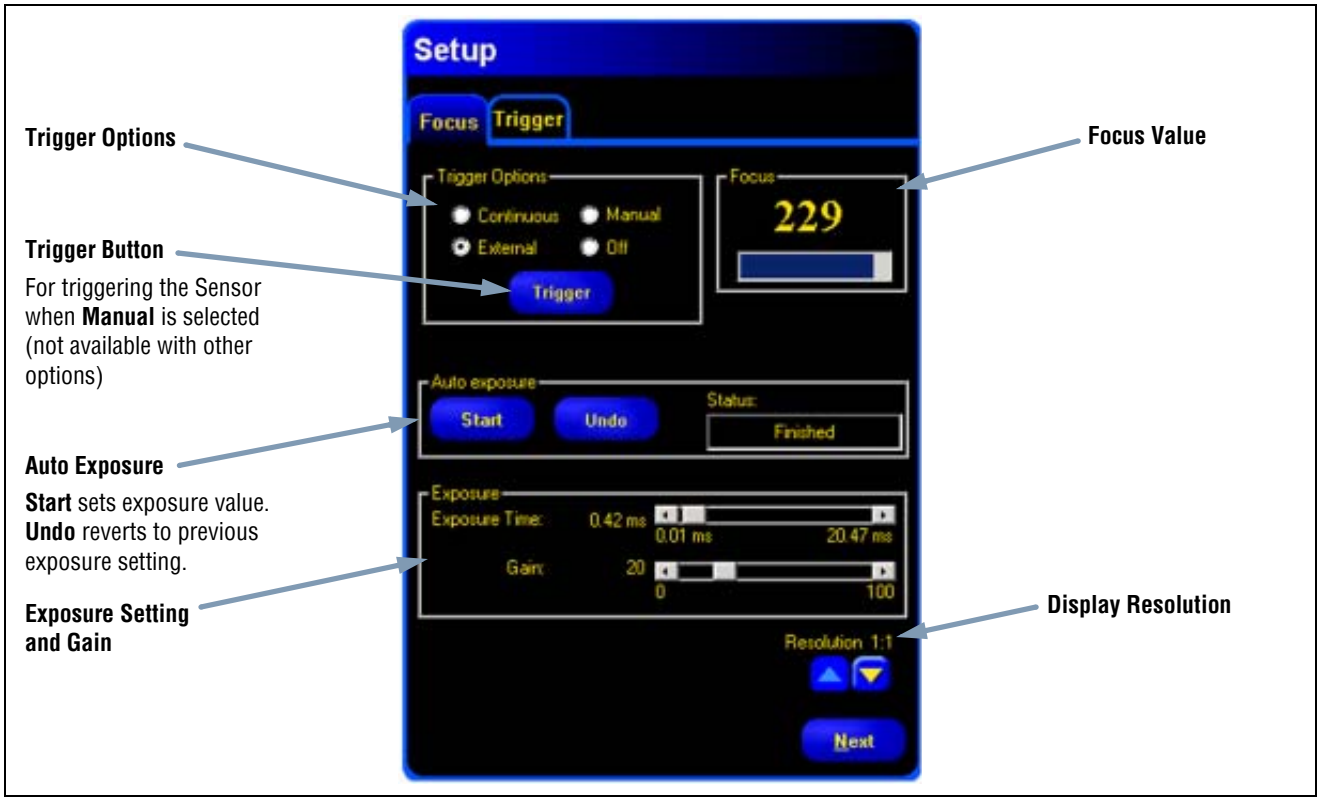
# Capturing a Reference Image

The reference image is used as a template for developing an inspection. The Vision tools use this image to acquire the critical information needed for the inspection.

Acquiring a quality image is crucial for a successful inspection. A quality image shows a measurable and repeatable difference between good products (which pass inspection) and bad products (which fail inspection).

## Focus Tab

Click on the **Focus** tab in the Setup Configuration window to capture a reference image.




***Focus Tab Setup Options***

## Choosing a Trigger Type

The first step in capturing an image is determining when the Sensor should capture an image. This Setup option determines how the sensor initiates an image capture.

The Sensor can be triggered to capture an image in one of four ways. These trigger options are used only in Setup. See Setting Trigger Parameters on page 44 for setting up the inspection trigger.

**Trigger Options (default: Continuous)**

**Continuous:** The sensor updates continuously in Setup mode.

**External:** Images are acquired only in response to a signal from an external source (Pin 4 on the Sensor) as configured on the **Trigger** tab. Choose **External** if the part will be moving during the inspection. This will help capture an image with the same conditions as the inspection conditions.

NOTE: In Run mode, only the external trigger is used.

**Manual:** Images are acquired only when the **Trigger** button is clicked. The Trigger button is grayed out when any trigger option other than Manual is chosen.

**OFF:** Choose this option to stop acquiring images. The last image acquired will remain on the display.

## Setting Exposure and Gain

Exposure Time and Gain settings are used to control the brightness of an image.

- Exposure time is the amount of time the Sensor allows light to energize the image chip. Increasing the exposure time allows more light to energize the image chip, which brightens the image.
- Gain is an electronic boost to the image signal. Increasing gain increases image brightness without increasing exposure time.

  NOTE: Gain brightens both the light pixels and dark pixels. High gain values will make the image appear grainy.

There are two ways to adjust exposure time and gain: use the Auto Exposure routine or adjust the settings manually. See the Auto Exposure Window on page 41.

To run the Auto Exposure routine, click **Start**.

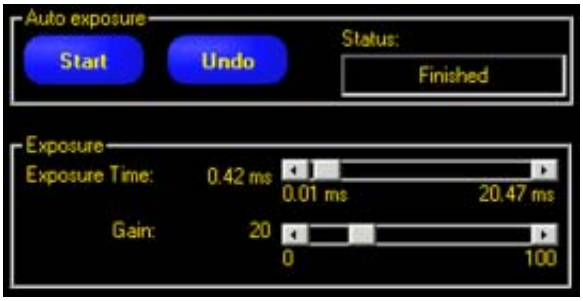
As the Auto Exposure routine runs, the exposure time and the gain will optimize for the current inspection, and the **Status** field will provide feedback. To halt the routine immediately, click **Stop**.

The following table explains each status in the **Status** field of the Focus tab:

***Status Field Options***

| Status | Explanation |
|---|---|
| Not running | Auto exposure has not been activated since entering this screen. |
| Running | Auto exposure is currently running. |
| Finished | Auto exposure has run and is complete. |
| Image too dark | The routine could not brighten the image enough. Add more light to the inspection. |
| Image too bright | The routine could not darken the image enough. Remove light from the inspection. |

***Manual Exposure Time and Gain Settings***




**To adjust the exposure time and gain settings manually:**

Move the sliders in the Exposure window left or right. Move the sliders to the left to darken the image, and move them to the right to brighten the image.

To revert to previous exposure values, click the **Undo** button.

See the Auto Exposure Window illustration below.

**To Darken Image**

Shortest exposure time = 0.01 ms
Lowest gain = 0

**To Brighten Image**

Longest exposure time = 20.47 ms
Highest gain = 100

***Auto Exposure Window for PresencePLUS P4***

# Exposure Time Considerations

Consider the following when setting the exposure time:

- Exposure time affects how much light is needed to illuminate the part.
- Exposure time affects how fast a part can pass by the Sensor as its image is captured:
  - Short exposure times require bright light sources.
  - Bright light sources are less efficient and can have a shorter useful life.
  - Long exposure times can blur the images of fast-moving objects. An image is blurred if the part moves a distance greater than one picture element (pixel) of the image during the exposure time.

Use the following calculation to determine the maximum exposure time without blurring:

$$\text{Max. Exposure Time (ms)} = \frac{\text{Horizontal FOV}}{\text{Part Speed x 128}} \text{ x 1000}$$

Horizontal Field of View (FOV) is the width of the image in inches.

Part speed is the speed of the production line in inches per second.

To convert part speed in feet per minute to inches per second, multiply by 0.2.

### Exposure Time Example:

A part is moving along the conveyor at 25 feet per minute. What is the maximum exposure time?

25 feet per minute x 0.2 = 5" per second.

| TIP | Place a ruler in the FOV at the working distance, and observe the measurement of the FOV width in the Image window. Assume for this example that the FOV width is 5". |
|---|---|

### Therefore:

$$\text{Max. Exposure Time} = \frac{\text{5"}}{\text{5" per second x 128}} \text{ x 1000 = 7.81 ms}$$

# Focusing the Lens

To focus the lens, place the target object so that the area to be focused appears in the center of the displayed image. Turn the lens focus ring in small increments. There are two ways to determine whether optimal focus has been achieved:

1. View the image on the PC or video monitor, or
2. View the Focus value on the **Focus** tab.

### Image on PC or Video Monitor

Turn the focusing ring until the image becomes sharper and then starts to blur. Turn the focusing ring back until the focus is sharp (see below).

### Focus Value on Focus Tab

Turn the focusing ring until the **Focus** value increases and then starts to decrease. Turn the focusing ring back until the value is at the highest possible number between 1 and 255 (see below).

NOTE: The Focus value updates at a faster rate than does the image in the Image window.

Clicking on the **Trigger** tab brings up the Trigger Setup screen shown on page 44. Clicking **Next** brings up the Tools screen (see Section 6, Tools Screen beginning on page 47).

The buttons in the Main Menu toolbar also remain active.

***Image on PC and Focus Value***

# Setting Trigger Parameters

An external trigger is used to tell the Sensor when to capture an image. Set the parameters in the **Trigger** tab of the Setup window.

**Display Resolution**

Image window display resolution is a system-wide parameter and remains the same for all inspections. Resolution can be set in all Setup and Run screens. See Resolution (in Section 11, Run) on page 128.

NOTE: The resolution setting does not affect the image captured by the Sensor.

***Trigger Setup Screen***

Trigger parameters shown in the **Trigger** tab are stored in the inspection file and can be different for each inspection.

**Polarity**

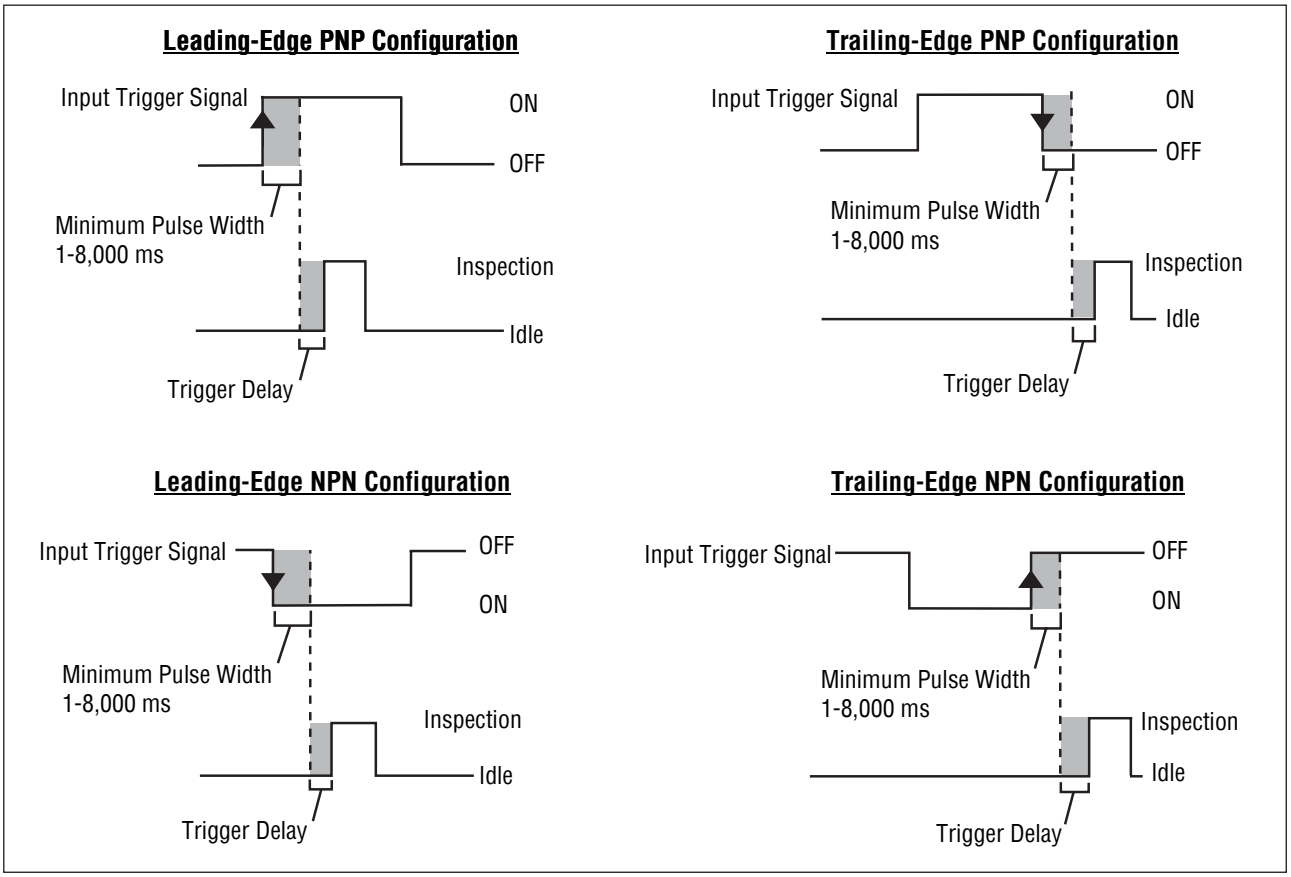
Choose **Leading Edge** to capture images at the leading edge of the trigger signal. Choose **Trailing Edge** to capture images at the trailing edge of the trigger signal.

## Input/Output Electrical Selection

All inputs and outputs can be selected as either NPN (current sinking) or PNP (current sourcing). This selection is made in the System Setup window on the **InputOutput** tab, which is shown in Electrical Selection (in Section 3, Installation) on page 13.

## Timing Diagram

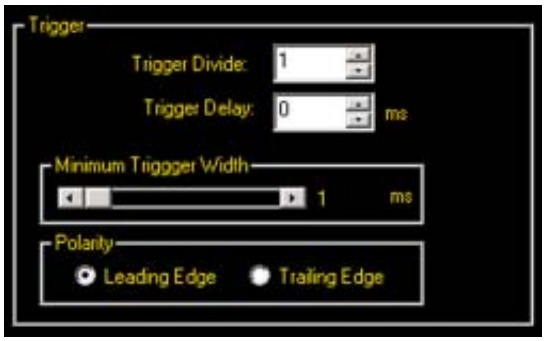
Polarity is illustrated in the Timing Diagram below.




***Timing Diagram: Leading-Edge and Trailing-Edge Trigger Inputs***

# Trigger Timing Options

The validity and timing of the trigger may be modified through three settings: Trigger Divide, Trigger Delay, and Minimum Trigger Width. Enter the appropriate values, or set the values by using the arrows.




**Trigger Divide (range: 1 – 10,000 triggers)**

Sets the sequence of valid triggers. If set to 1, an image is captured in response to every valid trigger; if set to 2, an image is captured in response to every second valid trigger, and so on.

**Trigger Delay (range: 0 – 8,000 ms)**

Fixed time (ms) from the instant the Sensor receives a valid trigger to the instant the Sensor captures the image.

See the Timing Diagram on page 45.

**Minimum Trigger Width (range: 1 – 8,000 ms)**

Eliminates unwanted triggers by accepting triggers only if they are above a specified length of time.

# 6. Tools Screen

This section explains how to build, open, modify, manage, and save inspection files.

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Selecting Inspections from the Library . . . . . 56

# Typical Build/Modify Procedure

## Establishing an Inspection

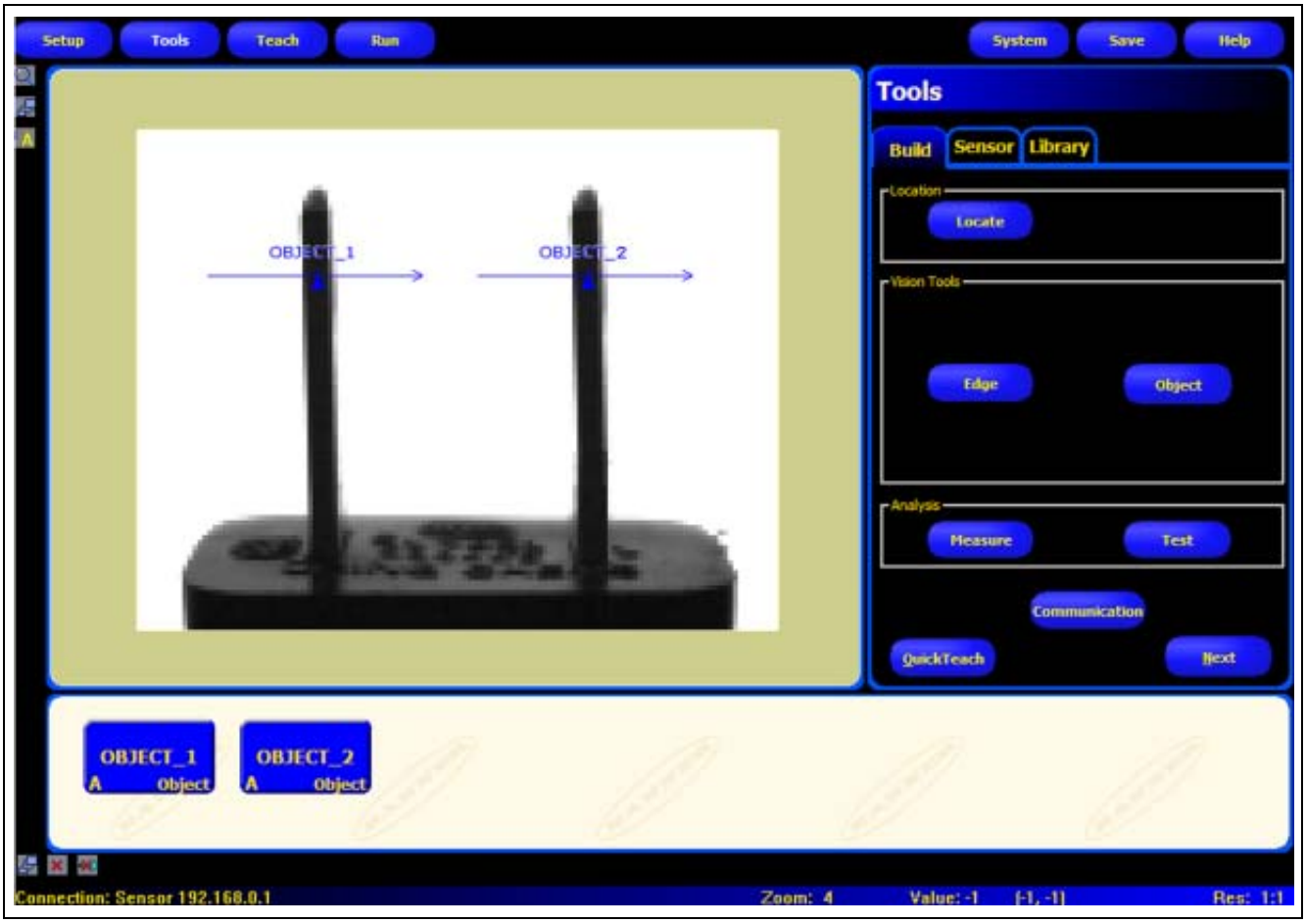
Using the Tools screen, shown below, the user establishes the inspections that the Sensor will execute. Three sources of inspections are available:

1. **Building an inspection from scratch** is the typical method of establishing an inspection. The Tools screen supports this inspection organization and is designed to aid the user in building an inspection.

   For detailed explanations of the tools, see Section 7, Tools beginning on page 57.

2. **Existing inspections can be obtained from the Sensor** (with or without the reference image) for execution or modification. This method is very useful if the user has an existing inspection on the Sensor and needs to make modifications to establish a new inspection.

3. **Existing inspections also can be obtained from host resources using the Library**. In this case, the sources of the inspections are the host's hard drive or network resources. This method provides access to an unlimited number of existing inspections for execution or modification.




***Tools Screen***

# Building and Modifying an Inspection

An inspection consists of both a *reference image* and an *inspection script*.

- The reference image is used as a template for building the inspection.
- The inspection script contains all the necessary information to run the inspection.

NOTE: A reference image must be captured or selected before building a new inspection. See Capturing a Reference Image (in Section 5, Setup) on page 39.

## Tools Screen Build Tab

Use the **Build** tab screen to do the following:

- Choose a tool
- Add or remove tools
- Configure tools
- Set inspection parameters manually, through Teach, or through Quick Teach

**To exit:**

Click **Next** to exit the Tools screen and go to the Teach screen.

Click **Quick Teach** to quickly set the tool parameters and go to the Run screen. The Sensor will add the tolerances on the inspection parameters that were selected in the Test tools.

***Tools Screen Build Tab***

The typical procedure for building or modifying an inspection is outlined below and explained in more detail later in this section.

1. Choose a tool.
2. Add a Region of Interest (ROI).
3. Set tool parameters.
4. Select **Quick Teach** or **Next** (to proceed to the Teach mode).

   NOTE: **Quick Teach** automatically sets judgment parameters by using the reference image as the target and applying the parameter tolerances selected in the Measure and Test tool(s). Once completed, Quick Teach prompts the user to save the inspection and proceeds automatically to the Run screen. Quick Teach provides the user with a very fast method of establishing candidate inspections.

   **Teach** automatically sets judgment parameters by running inspections on known good products. As an option, judgment parameters can be entered in the Test tool **Results** tab, and the inspection can be run without teaching.

   **CAUTION:** If Quick Teach or Teach is used, all “hand-entered” parameters will be overwritten.

5. Save the inspection to the Sensor before running it. See Section 14, Saving Inspections beginning on page 149.
6. Proceed to the Run screen to run the inspection.

## Choosing a Tool

Before adding tools or removing any tools from the inspection, read all of Section 6, Tools Screen, to become familiar with the tools. To choose the right tools for an inspection, consider the tool’s parameters and result options:

- Parameters are selected inputs for each tool (example: relative threshold).
- Results are the information returned from the tool after it has been executed.

Some tools perform evaluations, while others provide positional data for the tools that follow. Test tools evaluate, combine, or compare the results of other tools and determine a Pass-or-Fail judgment.

NOTE: Test tool must be chosen to evaluate the results of each tool or set of tools.

See Section 7, Tools beginning on page 57 for information about how the tools analyze images.

# Adding and Removing Tools

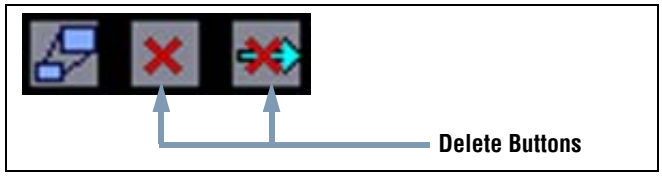
### To add a tool:

The following steps provide an overview for setting up Vision tools in an inspection. Steps not available for some of the Location or Analysis tools are noted.

1. Click the button of the tool to be added to the inspection.
2. Rename the tool.
   For more information, see Renaming Tools on page 51.
3. Draw the ROI (not available for Analysis tools).
   For more information, see Region of Interest (ROI) on page 52.
4. Set Input options to indicate the expected results (not available for the Test tool).
   For more information, see Examples of Logic Results (in Section 7, Tools) on page 93.
5. Add a Test tool.
6. Configure the Test tool inputs and, if desired, configure the desired results.
   See Test Tool Overview (in Section 7, Tools) on page 59.
7. Set the judgment parameters in one of three ways:
   - Use Quick Teach.
   - Use Teach.
   - Manually set the judgment parameters.

### To remove a tool:

1. Choose the tool to be removed in the Navigation/Results window.
2. Click the **Delete** button in the lower-left corner of the screen.




# Renaming Tools

The default name of each tool can be edited or replaced (examples: LOCATE_1, TT_2). Each name must be unique.

To edit the tool name, click on the **Name** field (double-click to select the entire name), and type to change or replace the name.

- Enter up to 49 characters; only alphanumeric characters and underscores (no spaces) are valid.
- The button in the Navigation/Results window that appears will show the first nine characters after exiting the tool.

# Region of Interest (ROI)

A Region of Interest (ROI) indicates the area of the image that the tool evaluates. The area outside the ROI is ignored but remains visible in the Image window. An ROI must be drawn for all Vision tools.

# ROI Types

ROI types include Area, Search and Pattern Area, and Linear. **Availability depends on the P4 Model.**

The following table lists the ROI type for each PresencePLUS P4 EDGE tool:

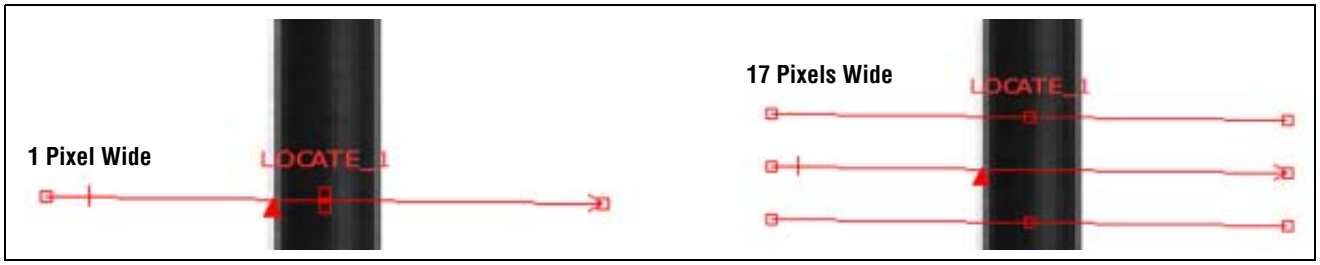
***ROI Types***

| P4 EDGE Tool | ROI Type |
|---|---|
| Locate | Linear |
| Edge | Linear |
| Object | Linear |

## Linear ROI

Linear ROIs are used by tools that scan along a defined line in a defined direction. Data are averaged along a linear ROI wider than 1 pixel to provide accurate test results. The ROI width is in increments of 4; for example 1, 5, 9, 13, and so on. The ROI widens symmetrically.

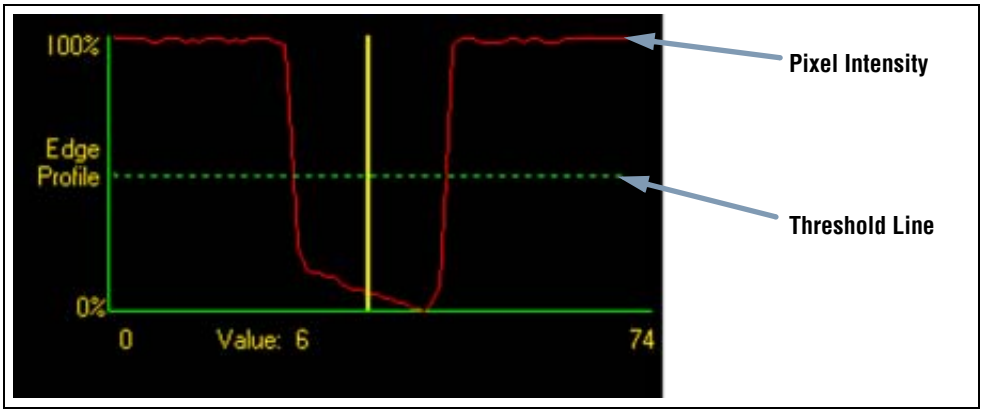
| TIP | Widening an ROI will give the user an average value/location. This will result in improved repeatability. |
|---|---|




***Linear ROIs with Left-to-Right Scan Direction***

## Linear Tool Profile Graph

The Tool Profile graph, shown below, is used with all linear ROIs. The graph represents the pixel values along the ROI. The vertical axis is representative of the gray scale or gradient level, and the horizontal axis represents the position (in pixels) along the ROI. The curve on the graph (red line on the screen) represents the edge profile, and the horizontal dashed line (green on the screen) represents the threshold level.

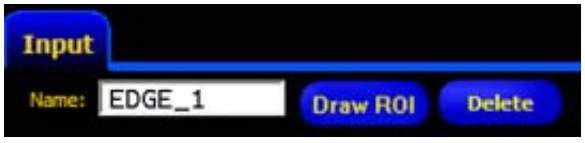
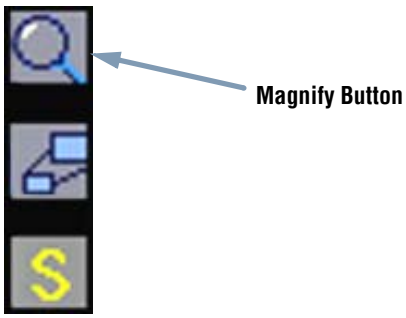



***Tool Profile Graph (Relative Threshold Shown)***

# Drawing ROIs

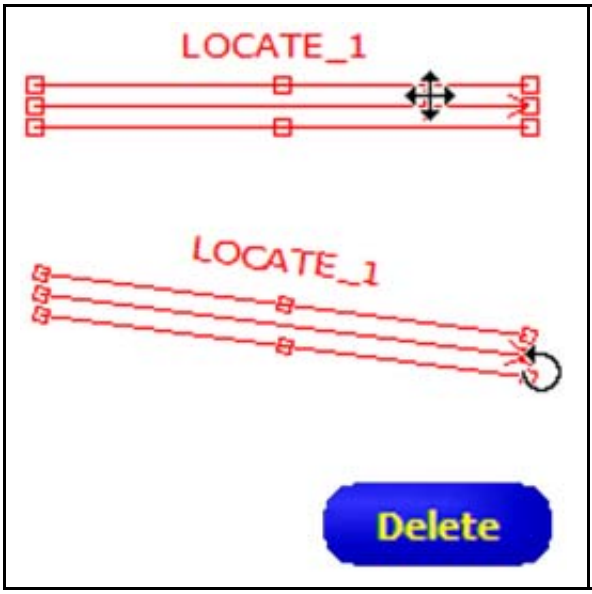
Use the following procedures to draw, move, edit, and delete ROIs.

### To Draw an ROI

| | |
|---|---|
|  | 1. Click on the **Draw ROI** button in the tool's **Input** tab. |
| | 3. Hold the mouse selection button, and drag the mouse to create the ROI shape in the Image window.<br>To move or edit the ROI after letting go of the mouse, see To Move, Edit, or Delete an ROI on page 54. |
|  | **TIP:** Use the Magnify button to the left of the Image window for a closer view of the ROI. |

### To Move, Edit, or Delete an ROI

Clicking on the tool in the Navigation window selects an ROI so it can be moved, edited, or deleted. Selection points indicate that the ROI is active.




**To Move an ROI**

1. Select the ROI, then hover the cursor inside it.
2. When the mouse cursor turns into a four-way arrow, drag the ROI to its new position.

**To Edit an ROI**

1. Hover the cursor over an end of the ROI. When the cursor turns into an arrow, indicating that the ROI can be rotated, click and drag.
2. Release the mouse button to release the ROI.

NOTE: When editing a Linear ROI, its length and position can be changed. The width can be manually entered in the tool's Input tab.

**To Delete an ROI**

Select the ROI, then click on **Delete** to delete it.

# Quick Teach

Quick Teach provides the fastest and easiest method of establishing an inspection. Quick Teach will use the reference image to establish Pass/Fail parameters of the Test tools.

For more information on Teach and Quick Teach, see Teach Overview (in Section 9, Teach) on page 114.

### Quick Teach does the following:

- Executes the inspection on the reference image.
- "Learns" the results of the Vision tools.
- Applies the applicable tolerances (user-determined, but default is 10%) to the selected parameters in the Test tool (these parameters determine the Pass/Fail criteria for each Test tool within the inspection).

  NOTE: Quick Teach will overwrite any manually-entered minimum and maximum parameter values in the Test tool.

### Click Quick Teach to:

- Run all the tools.
- Calculate the measurements.
- Add a percentage of tolerance around taught values.
- Save the inspection to the Sensor.
- Go to Run.

# Selecting or Deleting Inspections from the Sensor

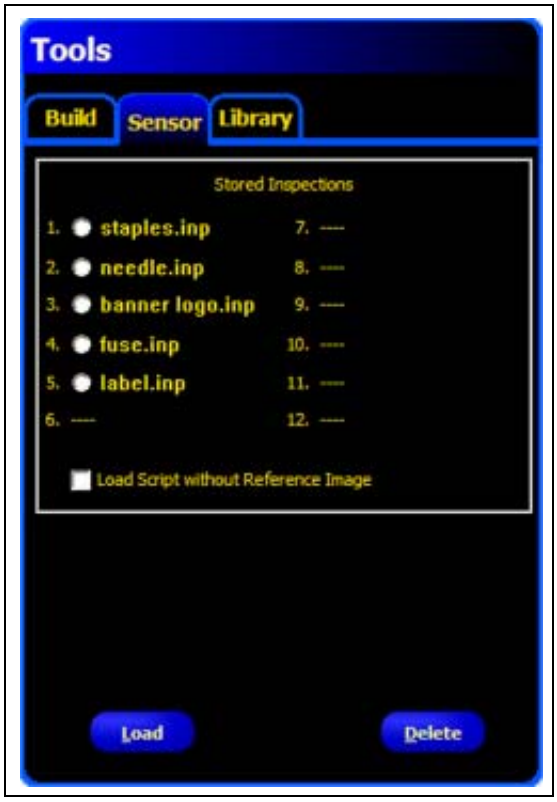
Up to 12 inspection files can be stored on the Sensor. Stored inspections can be modified, run, or deleted.

### To select and open an inspection from the Sensor:

1. Click the **Sensor** tab.
2. Select the desired inspection.
3. Click the **Load** button.

The tools from the selected inspection populate the Navigation/Results window, and the software returns to the **Build** tab. At this point, all tools in the inspection can be modified. If new tools are to be added, simply select the tool in the Tools screen. If tools are to be deleted, select the tool and click the **Delete** icon ( ) in the lower-left corner of the screen.

NOTE: If the image currently displayed on the screen will be the reference image (not the image stored with the inspection), check the **Load Script without Reference Image** box.




***Tools Screen Sensor Tab***

### To delete an inspection from the Sensor:

Click to select the inspection file, then click on **Delete**.

For help with saving inspections to the Sensor, see Section 14, Saving Inspections beginning on page 149.

# Selecting Inspections from the Library

Inspection files may be archived into a library on the PC or on a network connected to the PC.

After opening an inspection from the PC or network, modify it or save it to the Sensor.

### To select and open an inspection:

1. Click the **Library** tab.
2. Select the desired inspection.
3. Click the **Load** button.

The tools from the selected inspection populate the Navigation/Results window, and the software returns to the **Build** tab.

***Tools Screen Library Tab***

### To modify an inspection from the library:

See Building and Modifying an Inspection on page 49.

### To save an inspection:

See Section 14, Saving Inspections beginning on page 149.

# 7. Tools

This section explains the capabilities of the Sensor by explaining the tools.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# Tool Overviews

## Locate Tool Overview

See Locate Tool Setup on page 60 for information on setting up this tool.

The Locate tool locates the absolute or relative position of a target in a Field of View (FOV). This special edge detection tool detects the *first* transition between bright or dark pixels. This tool is initially set up around a feature that is in a repeatable position with respect to other features being inspected.

Examples:

- Locate the position of a label on a bottle
- Locate the position of a battery plate

## Edge Tool Overview

See Edge Tool Setup on page 70 for information on setting up this tool.

The Edge tool detects and counts transitions between bright and dark pixels. The total number of edges can be counted, and the position of each edge can be found. Edge position information can be used for distance and angle measurements.

Examples:

- Measure the height and width of a part
- Count the pins on a resistor
- Measure the height of a needle
- Measure the deflection of an automotive gauge
- Detect the edge of a web
- Verify that a bottle cap is on completely

## Object Tool Overview

See Object Tool Setup on page 79 for information on setting up this tool.

The Object tool detects the edges of dark and bright objects. From these edges, the Object tool measures the widths of every dark and light segment along the ROI. The Object tool calculates the width and midpoint for every object and counts the total number of objects. The midpoint can be used to measure distances and angles. Each object can have a unique size limit, or all objects may have the same size limit.

Examples:

- Measure the width of a label
- Locate the center of a box on a conveyor
- Measure the pitch and gap of pins on an integrated circuit (IC)
- Measure the gaps between stamped parts on a web

## Measure Tool Overview

See Measure Tool Setup on page 89 for information on setting up this tool.

The Measure tool calculates distance and angle measurements using other tools to generate positional data and measure distances between pattern centroids and Locate or the origin.

Examples:

- Measure the position of a label
- Verify that a bottle cap is screwed on completely
- Measure spark plug gap
- Calculate the position of a box on a conveyor

## Test Tool Overview

See Test Tool Setup on page 92 for information on setting up this tool.

The Test tool uses Boolean logic to combine or convert tool results. Its data can be used to evaluate the results of a single tool or multiple tools. The output of the Test tool can be used as input to another Test tool or to generate a discrete output. Additionally, a discrete input can be tied to a Test tool.

The Test tool displays the result ranges it is using as judgment criteria. Typically, these ranges are automatically set by Quick Teach or by teaching the inspection. In addition, they can be manually set or modified either before or after teaching or running the inspection. See Reviewing Results (in Section 9, Teach) on page 119. The Test tool also displays the results of the last image evaluated while setting up or running the inspection.

## Communication Tool Overview

See Communication Tool Setup on page 96 for information on setting up this tool.

The Communication tool is used to conditionally export inspection results to an external device. Results from Vision tools may be selected by the Communication tool and exported via the Sensor's serial channels or over Ethernet.

Examples of exported results:

- Execution times
- Whole-number counts
- Input and output values from Test tool
- Success from Locate, Edge, Object, and Test tools
- Reference point-to-edge and rotation distances

# Locate Tool Setup

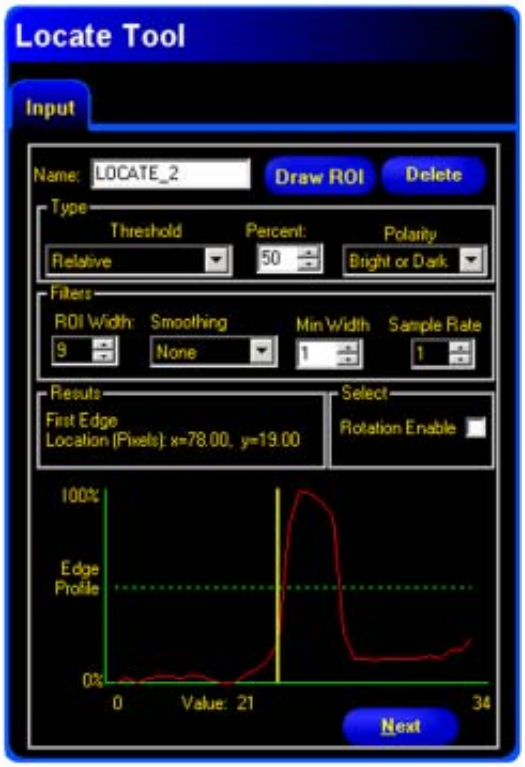
The Locate tool is an edge-based tool that finds the absolute or relative position of the target in an image by finding its first edge.

### Tools that follow the Locate tool do the following:

- Translate and rotate (if rotation is enabled) their ROIs relative to positional information from the Locate tool.
- Use the Locate tool as a reference for a measurement, instead of the absolute image position.
- Move, if it follows another Location tool. The Location tool in PresencePLUS P4 EDGE is Locate.
- Translate and rotate, if it follows another Location tool.

***Locate Tool Application***

# Locate Tool Configuration




**Locate Tool Applications:**

- Locate the position of a label on a bottle
- Locate the position of a battery plate
- Locate the edge of a box on a conveyor

| | |
|---|---|
| | **Name (default: LOCATE_1, LOCATE_2)**<br>- Used to rename the tool.<br>- The name can have only alphanumeric characters or underscores and no spaces. |
| | **Draw ROI button**<br>- Allows an ROI to be added.<br>- Locate tool uses linear ROIs, with one ROI for each Locate tool.<br>- The ROI's position and width can be modified. See Region of Interest (ROI) (in Section 6, Tools Screen) on page 52. |
| | **Delete button**<br>- Removes the ROI from the Image window.<br>- The active tool (red ROI on the screen) is removed. |

**Transition Type (default: Relative Threshold)**

The drop-down list of Locate tool transition types includes the following choices:

**Relative Threshold**

- Finds an edge at a relative pixel intensity.
- Is more tolerant of light fluctuations between inspections than other transition types.
- May find false edges.

**Absolute Threshold**

- Finds an edge at a specific gray scale level.
- Is less likely to find a false edge than other transition types.
- May miss edges if the light level changes between inspections.

**Edge Strength Threshold**

- Detects edges on surfaces that are not uniformly illuminated.
- Finds edges in low-contrast images.
- Is more tolerant of gradual changes in light levels across the tool than other transition types.
- Filters out weak or gradual edges.

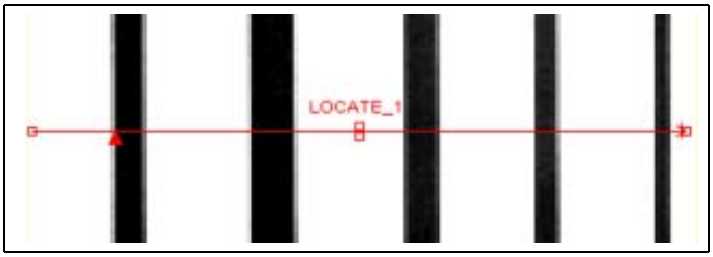
**Threshold Percent (default: 50)**
**Threshold Value (default: 128)**
**Threshold Edge Strength (default: 20)**

This option sets the threshold value (moves the dotted green line on the Edge Profile graphs).

- **Percent** is displayed when the Transition Type is Relative Threshold.
- **Value** is displayed when the Transition Type is Absolute Threshold.
- **Edge Strength** is displayed when the Transition Type is Edge Strength.

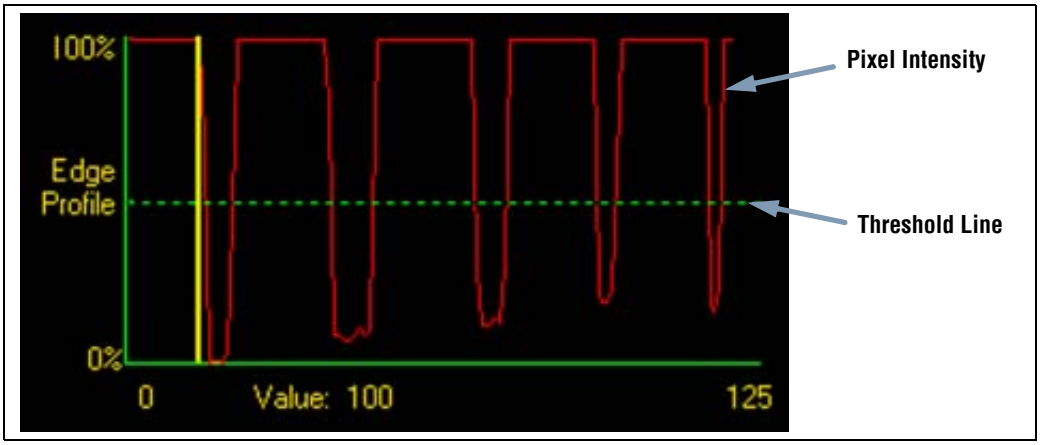
### Threshold Example

The following screen image shows a Locate tool scanning five bars from left to right with **Relative Threshold** selected.



In the Locate tool pixel graph below, the horizontal axis is the position in pixels along the Locate tool's linear ROI, and the vertical axis is the brightness level.

The dotted (green on the screen) line crossing the graph through the middle is the threshold. The solid (red on the screen) line is the pixel intensity along the ROI. An edge is found each time the pixel intensity (solid line) crosses the threshold (dotted line).




### More About Absolute and Relative Thresholds

The threshold is used to mark the gray scale transition point. The tool marks the edge when the pixel intensity crosses the threshold level.

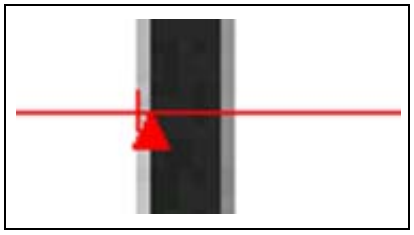
**Absolute Threshold** requires a specific gray scale level to be chosen.

**Relative Threshold** converts the range of gray levels found along the ROI into a percentage of light. The brightest gray scale level is 100% and the darkest is 0%. Choose the percentage value at which the edge should be marked.

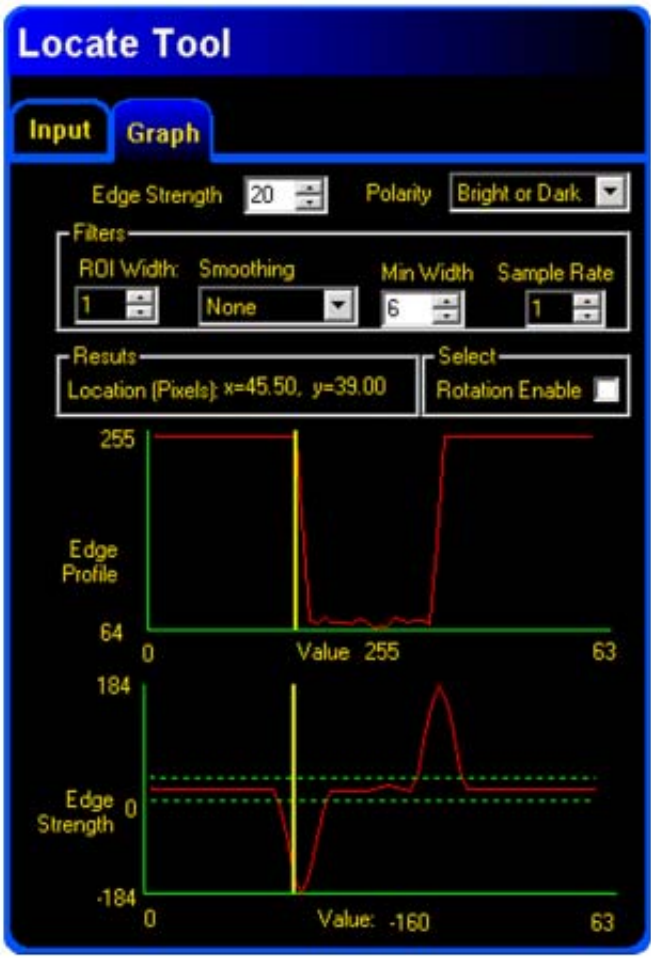
**Edge Strength Threshold** detects the rate of change in gray scale levels. The greater the change, the stronger the edge strength.

### Edge Strength Threshold

Instead of finding an edge at a specific pixel intensity level, **Edge Strength Threshold** is gradient-based; that is, it scans for changes in intensity levels along the ROI. An edge is found when the intensity change reaches a specific, set level.



**Example:** The image at left shows how a gradient-based edge is detected. It is a close-up view of the previous Threshold Example screen image.

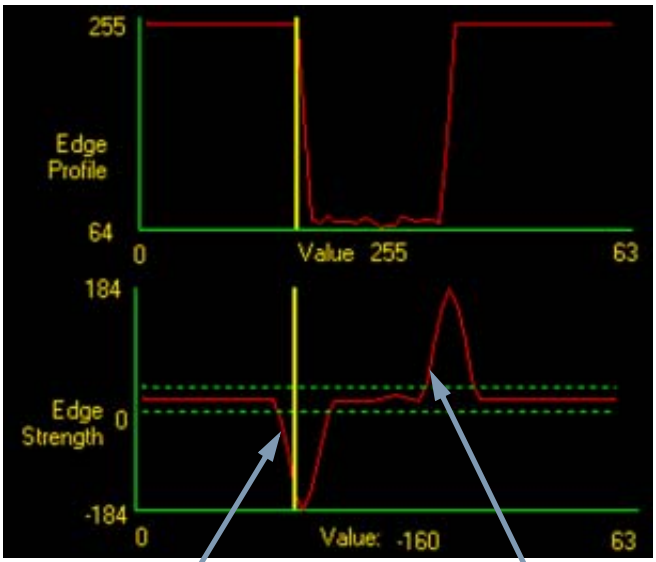



When **Edge Strength** is selected, the **Graph** tab appears on the tool window. The graph for the previous tab (in this case, the **Input** tab) overlays both the edge strength graph and the edge profile. In the **Graph** tab, the edge profile graph and the edge strength graph are separated for easier viewing.

The top graph at left, **Edge Profile**, represents the absolute gray scale level across the Locate tool.

The bottom graph, **Edge Strength**, represents the change in gray scale along the Locate tool.

Edge Strength detects an edge when the intensity change (solid red line on the screen) crosses the selected intensity change amount (dashed green lines on the screen).

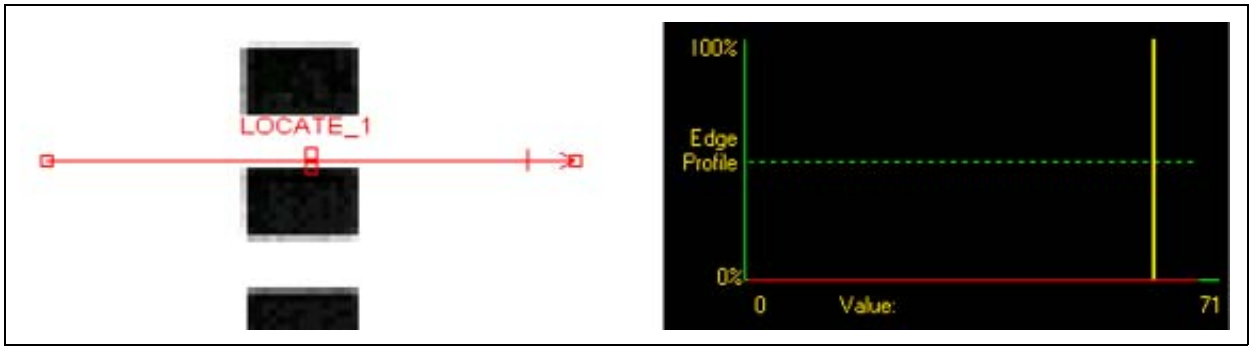



A bright-to-dark transition has a negative edge strength value, and a dark-to-bright transition has a positive edge strength value. When the Edge Strength level is adjusted, both the negative and positive lines will adjust together.

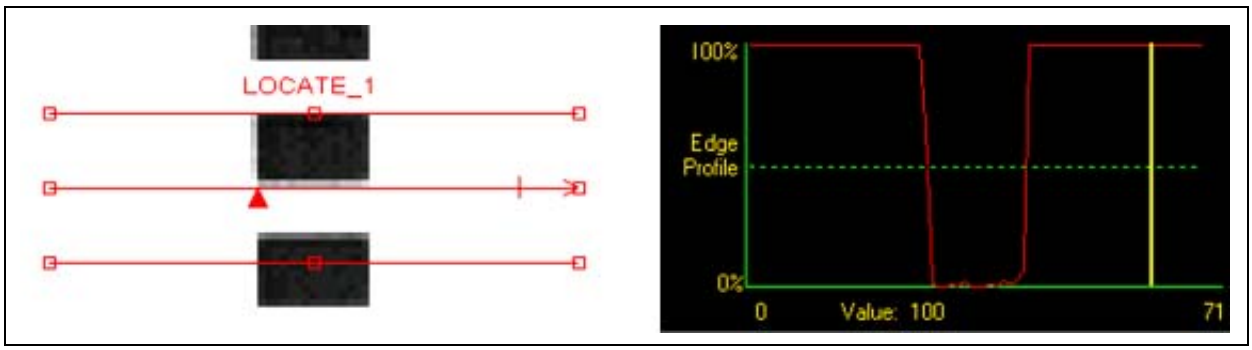
### ROI Width

| | |
|---|---|
| | **ROI Width (default: 1)**<br>- Width can be increased in increments of 4 pixels (1, 5, 9, 13, ...) up to the total FOV size.<br>- Narrow ROIs execute faster but could miss the part (see below).<br>- Wide ROIs are more consistent but don't execute as fast.<br>- To calculate rotation of a part, ROI width must be 13 or greater. |

The following image shows how a narrow ROI could miss the part if the part shifts up or down.



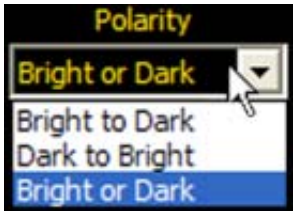

Widening the ROI, as shown below, makes it wide enough to always detect the thin bars. This wider line results in the tool consistently finding one edge every time.




### More About Widened ROIs

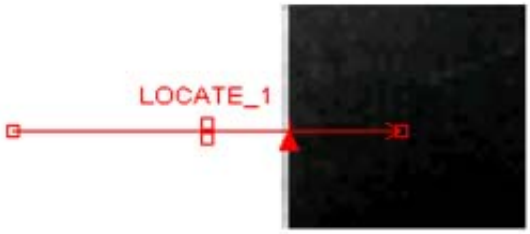
If the width of the ROI is greater than 1, the gray scale levels of the pixels are averaged along the width of the ROI. The averaged value helps smooth out jagged edges.

## Polarity

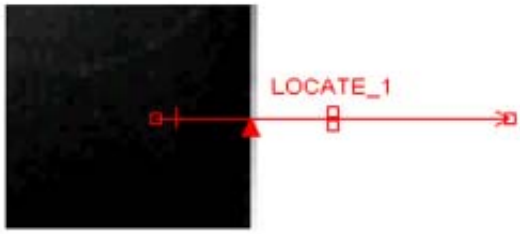



**Edge Polarity (default: Bright or Dark)**

- Choose **Bright to Dark** to find edges that start above the threshold value and cross below the threshold value.
- Choose **Dark to Bright** to find edges that start below the threshold value and cross above the threshold value.
- Choose **Bright or Dark** to find any edge.

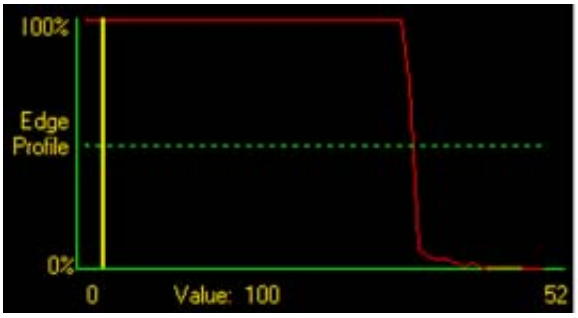



**Bright-to-Dark Edge**

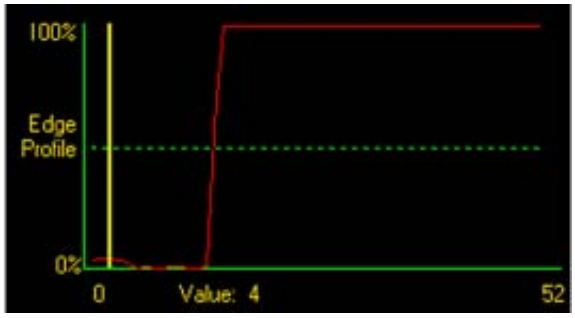



**Dark-to-Bright Edge**

The Locate tool will find all bright-to-dark edges and all the dark-to-bright edges. Using Edge Polarity helps to filter out unwanted edges.




**Edge Profile of Bright-to-Dark Edge**



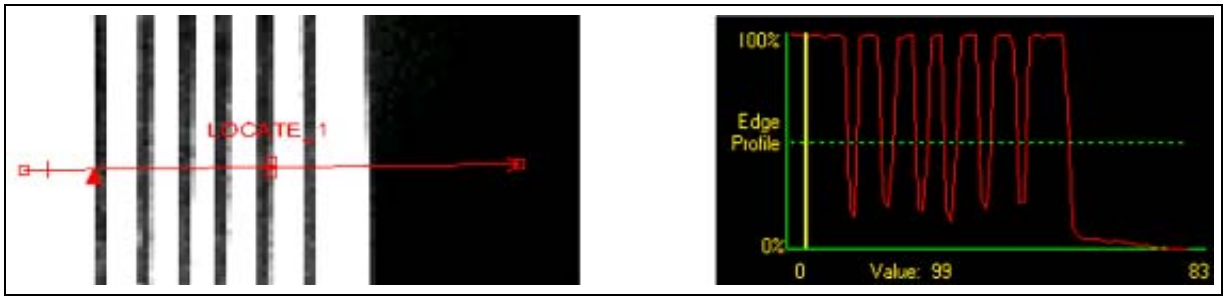

**Edge Profile of Dark-to-Bright Edge**

### Smooth Filter

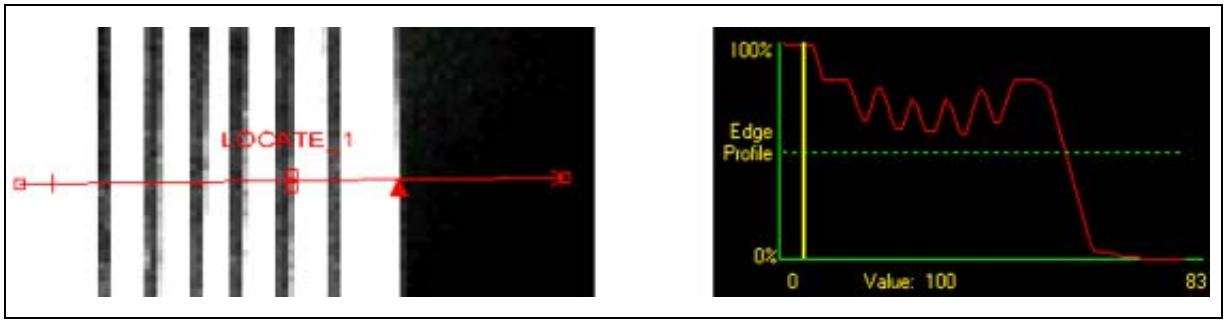
**Smooth Filter (default: None, range: None to 5)**
- Runs a rolling average along the ROI length.
- Filters out small sharp changes in the edge profile.
- A high filter number may miss the edge of a narrow line.

### Smoothing Example

In the following image, the Smooth filter is set to **None**, so the Locate tool finds the first narrow line.




In the following image, the Smooth filter is set to 3. The Smooth filter averages a segment of pixels along the ROI, which smoothes the sharp spikes of the dark lines. After the lines are smoothed, the Locate tool ignores them because they are below the threshold.




### More About the Filter

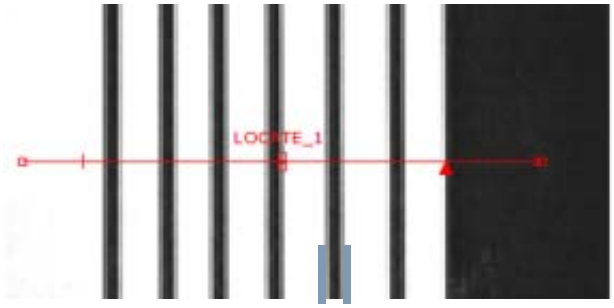
The smooth filter calculates a rolling average of the edge profile; the rolling average width increases with the smooth number.

### Minimum Width

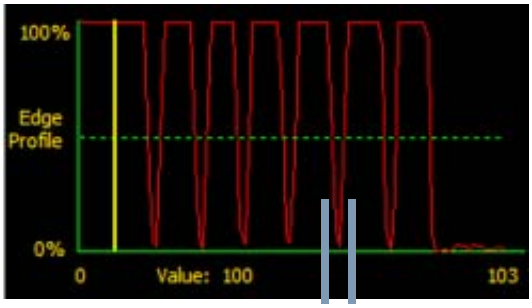
| | |
|---|---|
| | **Minimum Width (default: 1)**<br>- Filters out small spike-of-intensity changes.<br>- Filters out narrow dark or bright bands.<br>- Determines the distance (in pixels) before and after an edge that must be free from additional transitions or the end of the FOV before the edge is recognized (see the following Minimum Width Example).<br>- A high filter number may miss the edge of a narrow line. |

### Minimum Width Example

When the Minimum Width is set to 5, the Locate tool ignores the dark lines, because each line is only 3 pixels wide.




**3 pixels wide**




**3 pixels wide**

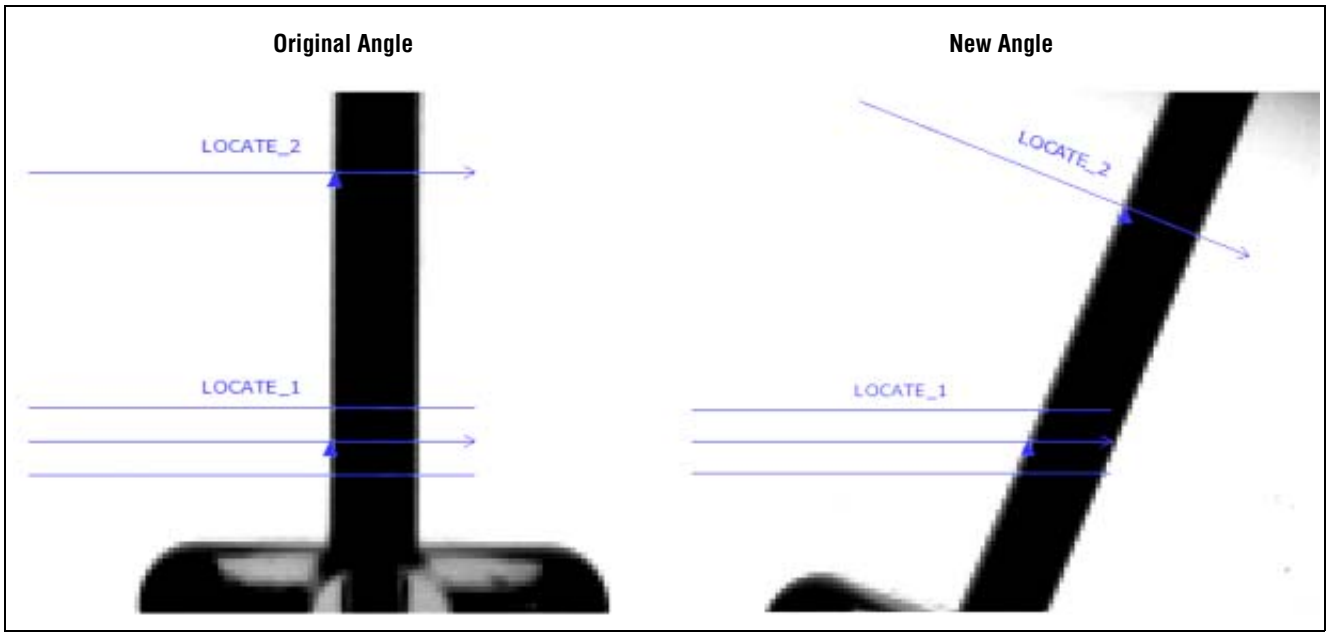
### Sample Rate and Rotation

| | |
|---|---|
| | **Sample Rate (default: 1, range: 1–4)**<br>**1** = 1-pixel resolution<br>**2** = 1/2-pixel resolution<br>**3** = 1/3-pixel resolution<br>**4** = 1/4-pixel resolution<br>Determines the subpixel resolution, increases the resolution of the tool, and increases the inspection time. |
| | **Rotation Enable (default: unchecked)**<br>- Activates the rotation compensation calculation.<br>- ROIs that follow will rotate according to the difference between the reference image and the current inspection image.<br>- ROI width must be 13 or greater. |

| | |
|---|---|
| **TIP** | - Keep the ROIs close to a 90° angle from the desired edge.<br>- When using two Locate tools, position them 90° apart and, if enabling rotation, enable rotation on the first tool. |
| **WARNING** | When rotation is enabled, the edge must be straight, free of breaks and indentations, and must not include a corner. |

### More About Rotation

When Enable Rotation is activated, all subsequent ROIs will rotate relative to the edge found. During Setup, the Locate tool calculates the angle of the edge found. During inspection, the new angle is compared to the original angle. If there is any rotational change between the original angle and the new angle, all ROIs after the Locate tool will rotate by that amount.




## Locate Tool Results

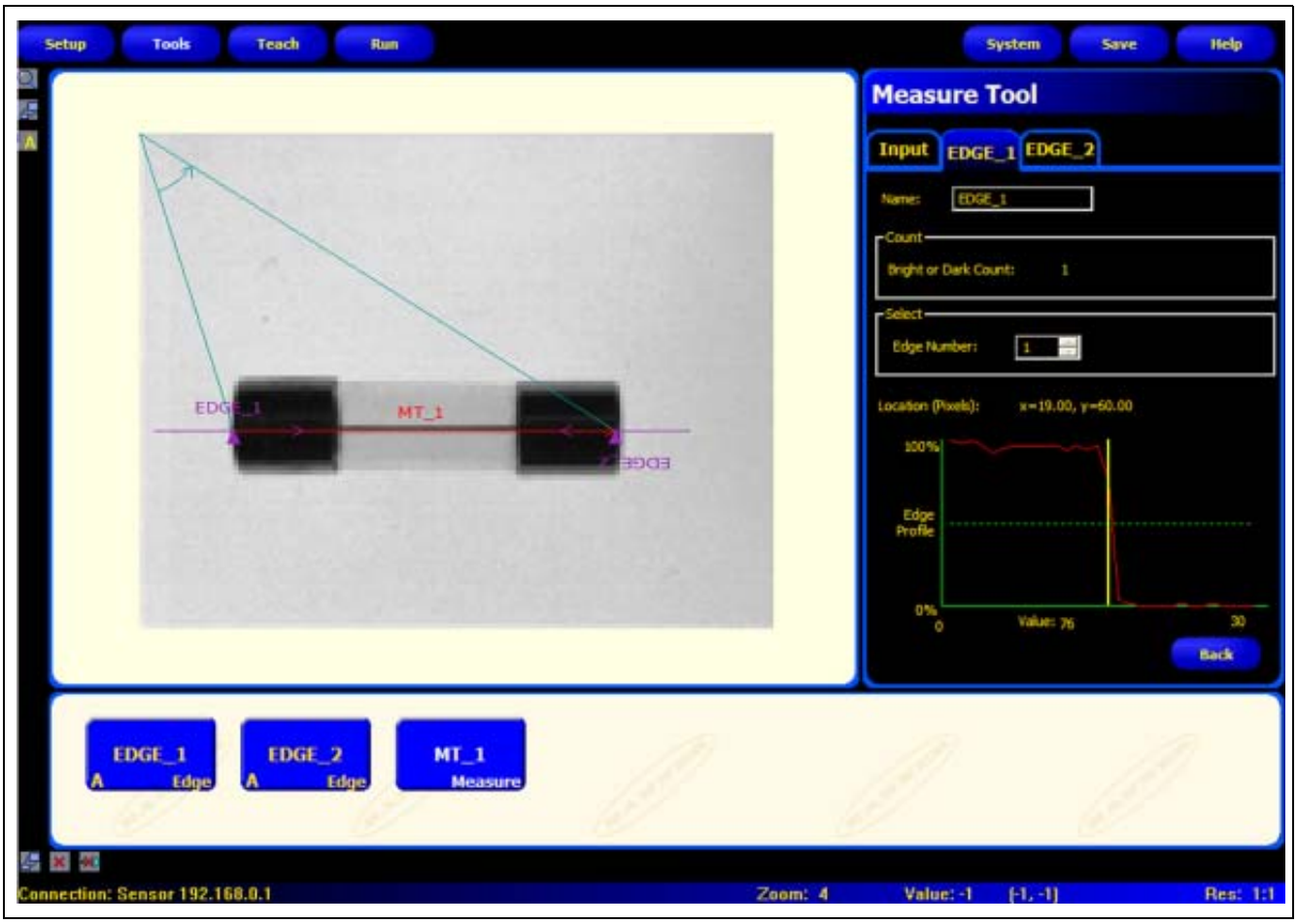
| Name | Value | Description |
|---|---|---|
| First Edge Location | pixels (X,Y) | The position of the first edge. The origin (0,0) is the upper-left corner of the screen. |

# Edge Tool Setup

The Edge tool identifies edges along a selected linear ROI by finding transitions between bright and dark pixels.

**Information captured by the Edge tool can be used to:**

- Count edge transitions
- Find the position between transitions
- Provide distance and angle information to the Measure tool

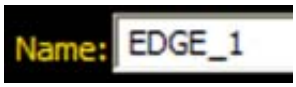



***Edge Tool Application***

# Edge Tool Configuration

**Edge Tool Applications:**

- Measure the height and width of a part
- Count pins on a resistor or IC
- Measure the height of a needle
- Measure the deflection of an automotive gauge
- Detect the edge of a web
- Verify that a bottle cap is on completely

| | |
|---|---|
|  | **Name (default: EDGE_1, EDGE_2)**<br>- Used to rename the tool.<br>- The name can have only alphanumeric characters or underscores and no spaces. |
| | **Draw ROI button**<br>- Allows an ROI to be added.<br>- Edge tool uses a linear ROI. See Region of Interest (ROI) (in Section 6, Tools Screen) on page 52. |
| | **Delete button**<br>- Removes the ROI from the Image window.<br>- The active tool (red ROI on the screen) is removed. |

**Transition Type (default: Relative Threshold)**

The drop-down list of Edge tool transition types includes the following choices:

**Relative Threshold**

- Finds an edge at a relative pixel intensity.
- Is more tolerant of light fluctuations between inspections than other transition types.
- May find false edges.

**Absolute Threshold**

- Finds an edge at a specific gray scale level.
- Is less likely to find a false edge than other transition types.
- May miss edges if the light level changes between inspections.

**Edge Strength Threshold**

- Detects edges on surfaces that are not uniformly illuminated.
- Finds edges in low-contrast images.
- Is more tolerant of gradual changes in light levels across the tool than other transition types.
- Filters out weak or gradual edges.

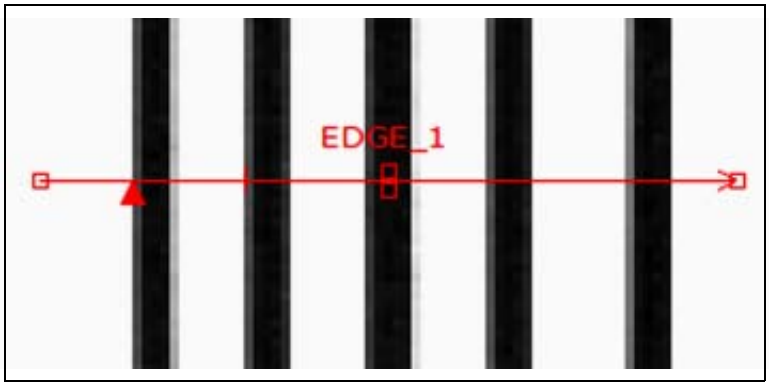
**Threshold Percent (default: 50)**
**Threshold Value (default: 128)**
**Threshold Edge Strength (default: 20)**

This option sets the threshold value (moves the dotted green line on the Edge Profile graphs).

- **Percent** is displayed when the Transition Type is Relative Threshold.
- **Value** is displayed when the Transition Type is Absolute Threshold.
- **Edge Strength** is displayed when the Transition Type is Edge Strength.

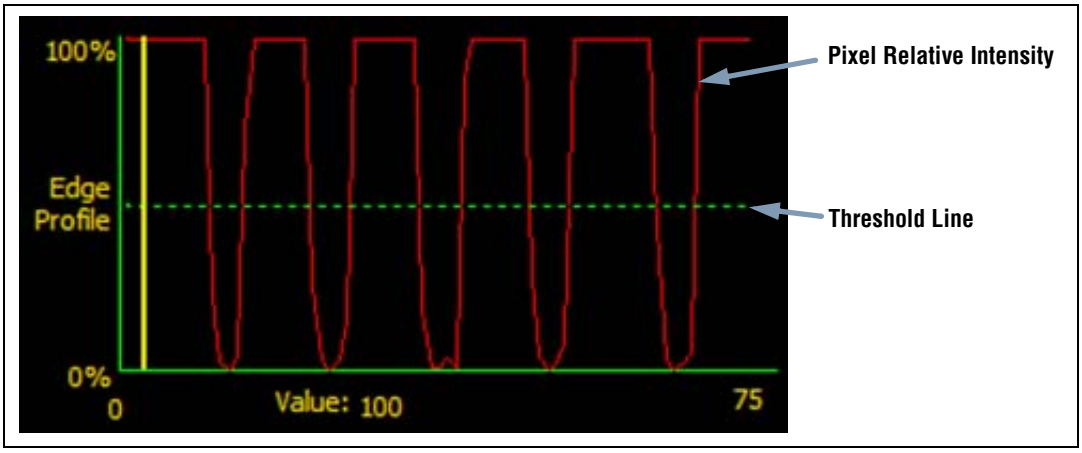
### Threshold Example

The following screen image shows an Edge tool, scanning five bars from left to right with **Relative Threshold** selected.



In the Edge tool pixel graph below, the horizontal axis is the position, in pixels, along the Edge tool's linear ROI, and the vertical axis is the brightness level.

The dotted line (green on the screen) crossing the graph through the middle is the threshold. The solid (red on the screen) line is the pixel intensity along the ROI. An edge is found each time the pixel intensity (solid line) crosses the threshold (dotted line).




### More About Absolute and Relative Thresholds

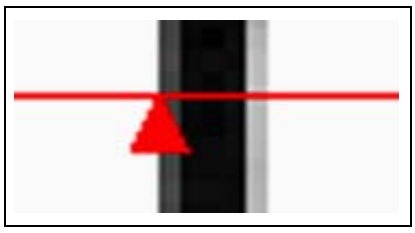
The threshold is used to mark the gray scale transition point. The tool marks the edge when the pixel intensity crosses the threshold level.

**Absolute Threshold** requires a specific gray scale level to be chosen.

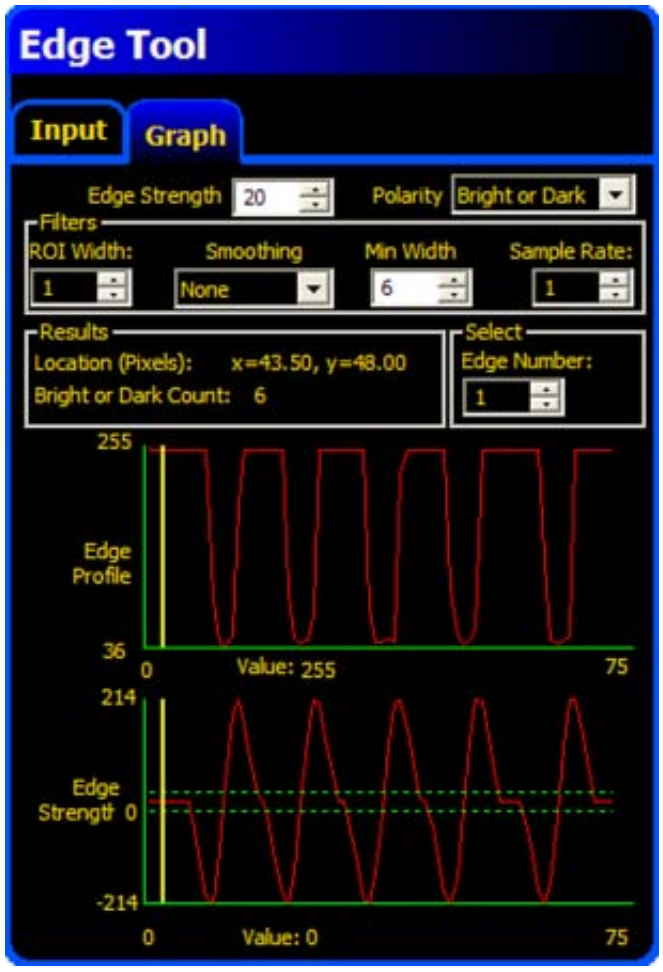
**Relative Threshold** converts the range of gray levels found along the ROI into a percentage of light. The brightest gray scale level is 100% and the darkest is 0%. Choose the percentage value at which the edge should be marked.

### Edge Strength Threshold

Instead of finding an edge at a specific pixel intensity level, **Edge Strength Threshold** is gradient-based; that is, it scans for changes in intensity levels along the ROI. An edge is found when the intensity change reaches a specific, set level.



**Example:** The image at left shows how a gradient-based edge is detected. It is a close-up view of the previous Threshold Example screen image.

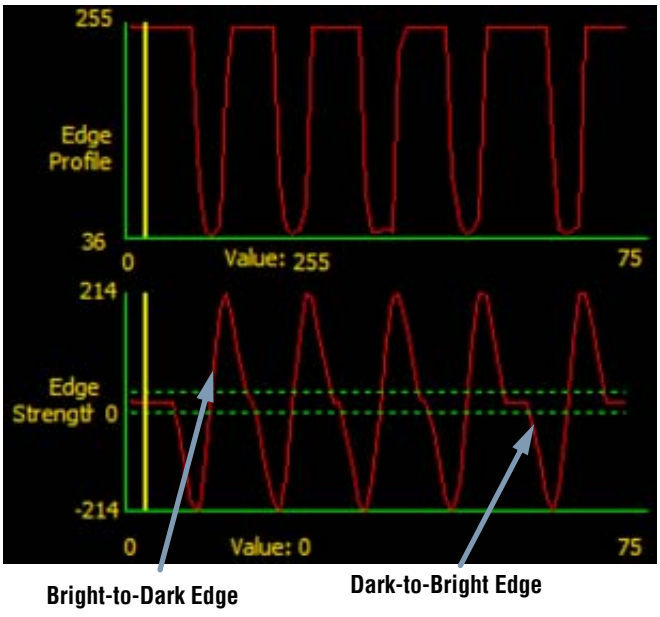



When **Edge Strength** is selected, another tab appears on the tool window. The graph for the previous tab (in this case, the **Input** tab) overlays both the edge strength graph and the edge profile. In the **Graph** tab, the edge profile graph and the edge strength graph are separated for easier viewing.

The top graph at left, **Edge Profile**, represents the absolute gray scale level across the Edge tool.

The bottom graph, **Edge Strength**, represents the change in gray scale along the Edge tool.

Edge Strength detects an edge when the intensity change (solid red line on the screen) crosses the selected intensity change amount (dashed green lines on the screen).

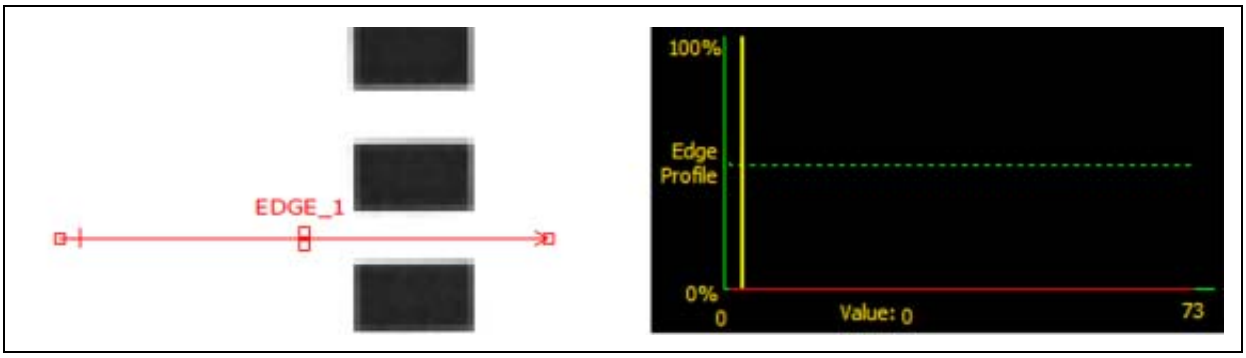



A bright-to-dark transition has a negative edge strength value, and a dark-to-bright transition has a positive edge strength value. When the Edge Strength level is adjusted, both the negative and positive lines will adjust together.

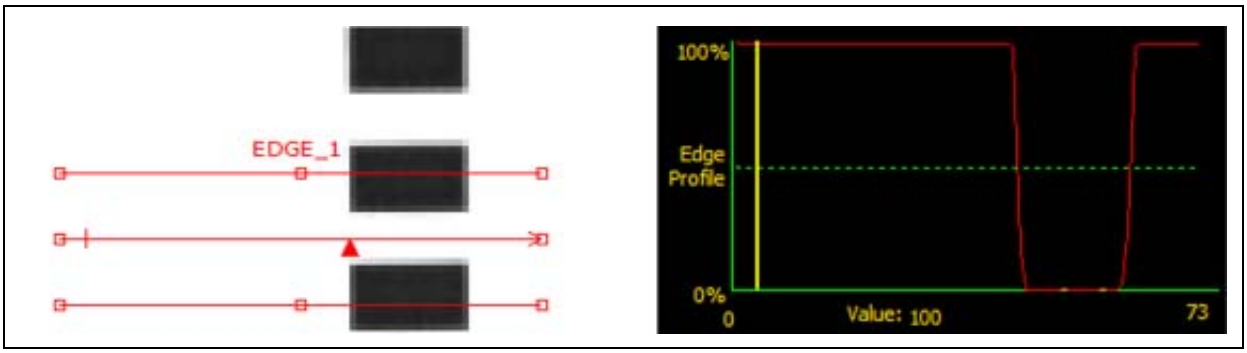
### ROI Width

| | |
|---|---|
| | **ROI Width (default: 1)**<br>- Width can be increased in increments of 4 pixels (1, 5, 9, 13, ...) up to the total FOV size.<br>- Narrow ROIs execute faster but could miss the part (see below).<br>- Wide ROIs are more consistent but don't execute as fast.<br>- A high filter number may miss the edge of a narrow line. |

**Example:** The images below show how a narrow ROI could miss the part if the part shifts up or down.



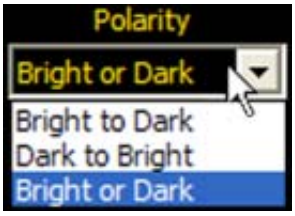

Widening the ROI, as shown below, makes it wide enough to always detect the thin bars. This wider line results in the tool consistently finding one edge every time.




### More About Widened ROIs

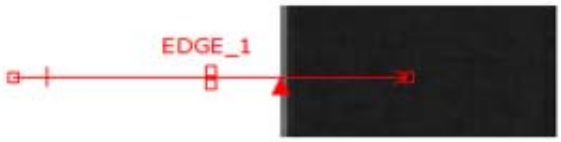
If the width of the ROI is greater than 1, the gray scale levels of the pixels are averaged along the width of the ROI. The averaged value helps smooth out jagged edges.

### Edge Polarity




**Edge Polarity (default: Bright or Dark)**

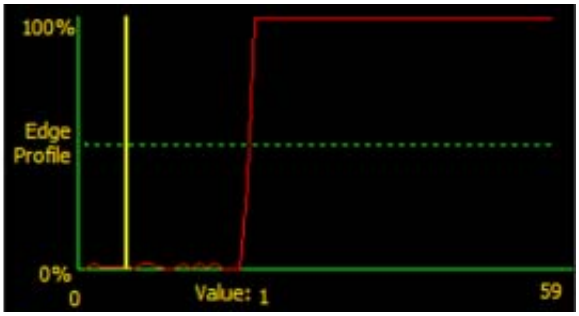
- Choose **Bright to Dark** to find edges that start above the threshold value and cross below the threshold value.
- Choose **Dark to Bright** to find edges that start below the threshold value and cross above the threshold value.
- Choose **Bright or Dark** to find any edge.




**Bright-to-Dark Edge**

**Dark-to-Bright Edge**

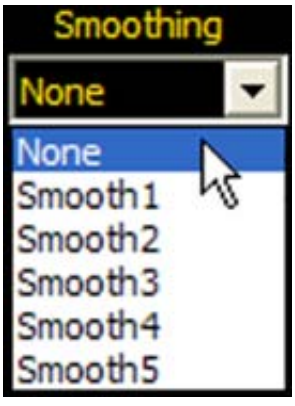
**Edge Profile of Bright-to-Dark Edge**




**Edge Profile of Dark-to-Bright Edge**

The Edge tool will find all bright-to-dark edges and all dark-to-bright edges. Using Edge Polarity helps to filter out unwanted edges.

### Smooth Filter

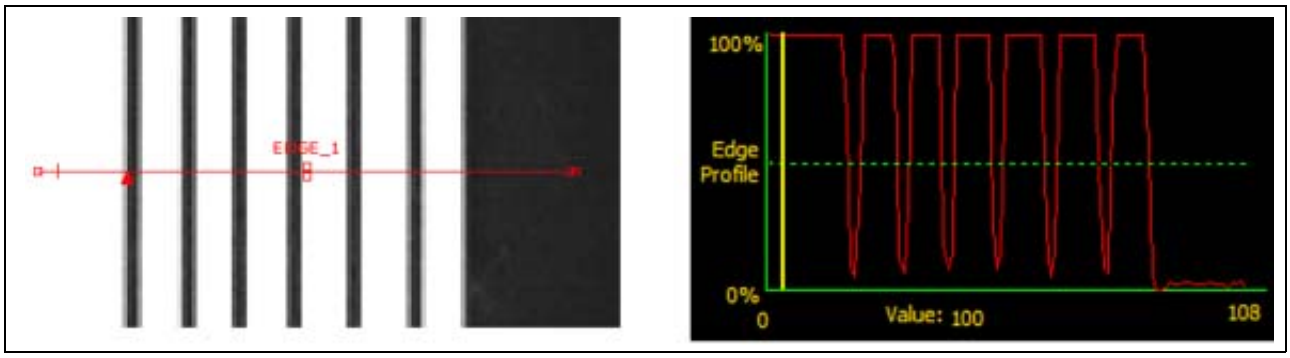



**Smooth Filter (default: None, range: None to 5)**

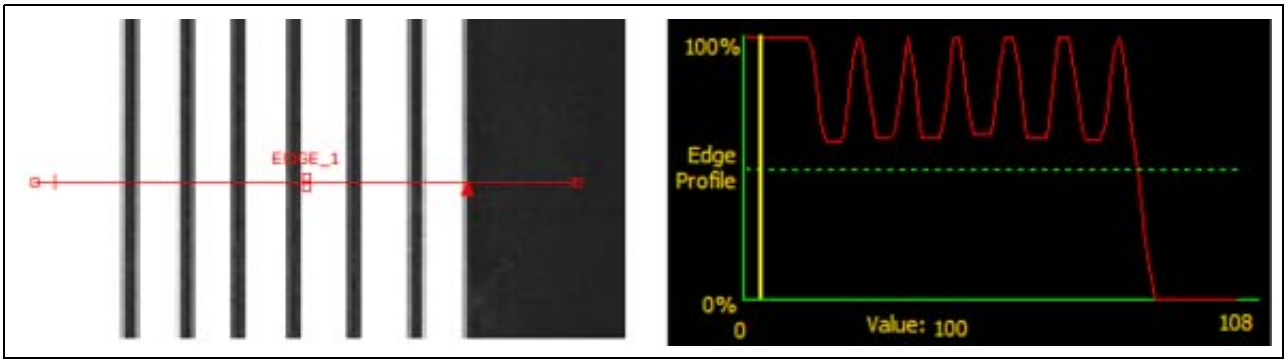
- Runs a rolling average along the ROI length.
- Filters out small sharp changes in the edge profile.
- A high filter number may miss the edge of a narrow line.

### Smoothing Example

In the following image, the Smooth filter is set to **None**, so the Edge tool finds the first narrow line.




In the following image, the Smooth filter is set to 3. The Smooth filter averages a segment of pixels along the ROI, which smoothes the sharp spikes of the dark lines. After the lines are smoothed, the Edge tool ignores them because they do not cross the threshold.




### More About the Smooth Filter

The smooth filter calculates a rolling average of the edge profile; the rolling average width increases with the smoothing number.

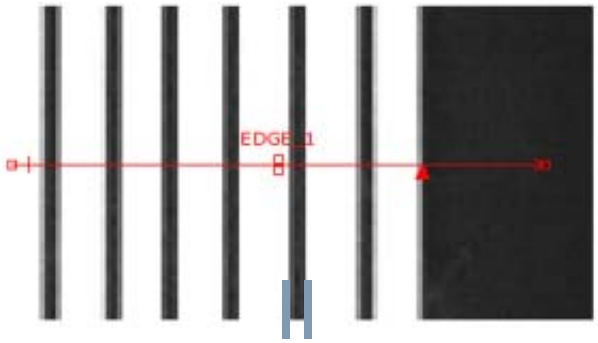
### Minimum Width

**Minimum Width (default: 1)**

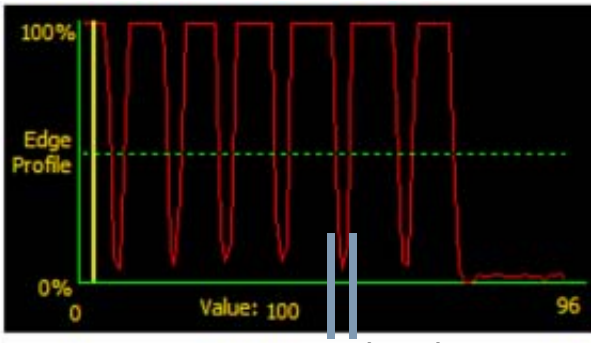
- Filters out small spike-of-intensity changes.
- Filters out narrow dark or bright bands.
- Determines the distance (in pixels) before and after an edge that must be free of additional transitions or the end of the FOV before the edge is recognized (see the Minimum Width Example below).
- A high filter number may miss the edge of a narrow line.

### Minimum Width Example

When the Minimum Width is set to **4**, the Edge tool ignores the dark lines, because each line is only 3 pixels wide.




**3 pixels wide**




**3 pixels wide**

### Sample Rate

**Sample Rate (default: 1, range: 1–4)**

**1** = 1-pixel resolution
**2** = 1/2-pixel resolution
**3** = 1/3-pixel resolution
**4** = 1/4-pixel resolution

- Determines the subpixel sampling
- Increases the resolution of the tool
- Increases the inspection time

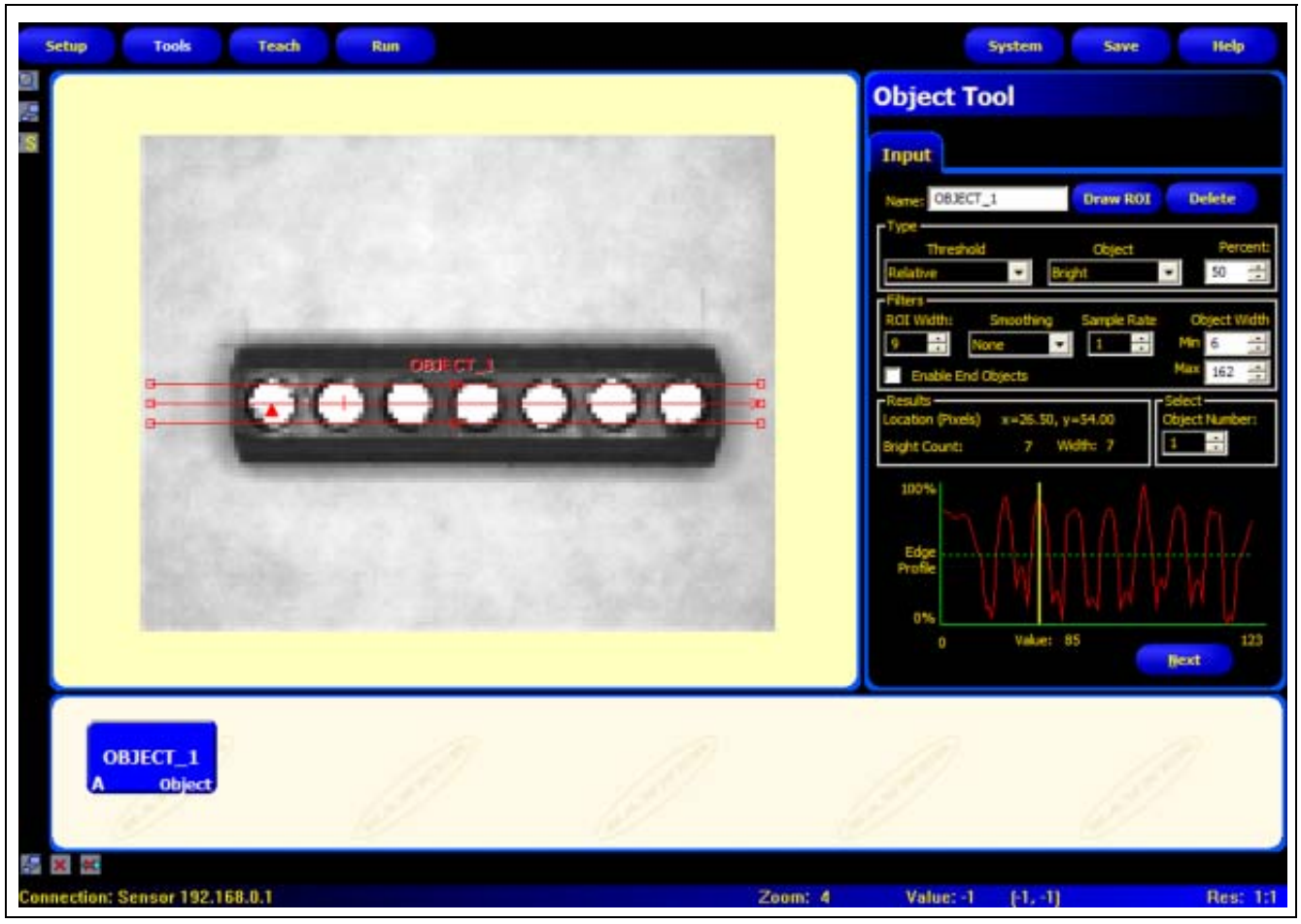
## Edge Tool Results

| Name | Value | Description |
|---|---|---|
| Location | pixels (X,Y) | The X,Y coordinates of the current edge. The origin (0,0) is the upper-left corner of the screen. |
| Current Edge | edge number | If more than one edge is found, use this selector to select an edge to analyze. |
| Count | whole number | Total number of bright-to-dark and dark-to-bright edges, depending on the Polarity option in effect. |

# Object Tool Setup

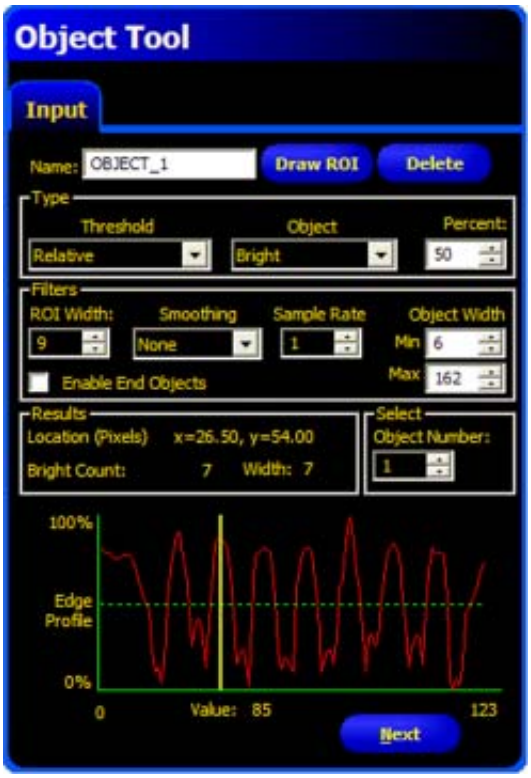
The Object tool finds objects along a linear ROI. Two edge transitions form an object. Data returned by the Object tool include the following:

- Number of objects
- Size of each object
- Centroid of each object




***Object Tool Application***

# Object Tool Configuration




**Object Tool Applications:**

- Measure width of label
- Locate center of box on conveyor
- Measure pitch and gap of pins on an IC
- Measure gaps between stamped parts on a web

| | |
|---|---|
| | **Name (default: OBJECT_1, OBJECT_2)**<br>- Used to rename the tool.<br>- The name can have only alphanumeric characters or underscores and no spaces. |
| | **Draw ROI button**<br>- Allows an ROI to be added.<br>- Object tool uses a linear ROI. See Region of Interest (ROI) (in Section 6, Tools Screen) on page 52. |
| | **Delete button**<br>- Removes the ROI from the Image window.<br>- The active tool (red ROI on the screen) is removed. |

**Transition Type (default: Relative)**

The drop-down list of Object tool transition types includes the following choices:

**Relative Threshold**

- Finds an edge at a relative pixel intensity.
- Is more tolerant of light fluctuations between inspections than other transition types.
- May find false edges.

**Absolute Threshold**

- Finds an edge at a specific gray scale level.
- Is less likely to find a false edge than other transition types.
- May miss edges if the light level changes between inspections.

**Edge Strength Threshold**

- Detects edges on surfaces that are not uniformly illuminated.
- Finds edges in low-contrast images.
- Is more tolerant of gradual changes in light levels across the tool than other transition types.
- Filters out weak or gradual edges.

**Object Polarity (default: Bright or Dark)**

- Choose **Bright or Dark** to find all objects.
- Choose **Bright** to find objects that are brighter than the background.
- Choose **Dark** to find objects that are darker than the background.

See Object Polarity on page 85 for an inspection example.

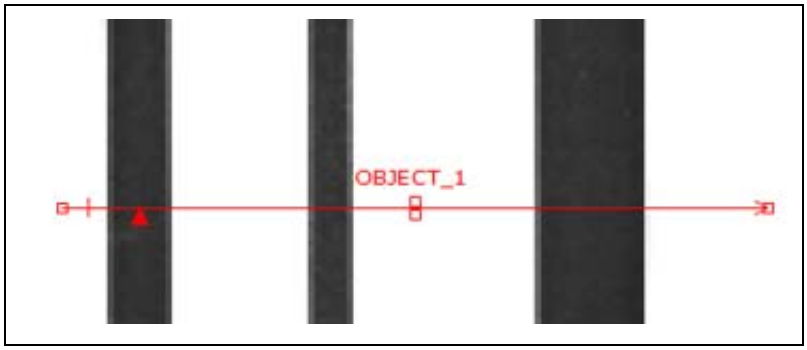
**Threshold Percent (default: 50)**
**Threshold Value (default: 128)**
**Threshold Edge Strength (default: 20)**

This option sets the threshold value (moves the dotted green line on the Edge Profile graphs).

- **Percent** is displayed when the Transition Type is Relative Threshold.
- **Value** is displayed when the Transition Type is Absolute Threshold.
- **Edge Strength** is displayed when the Transition Type is Edge Strength.

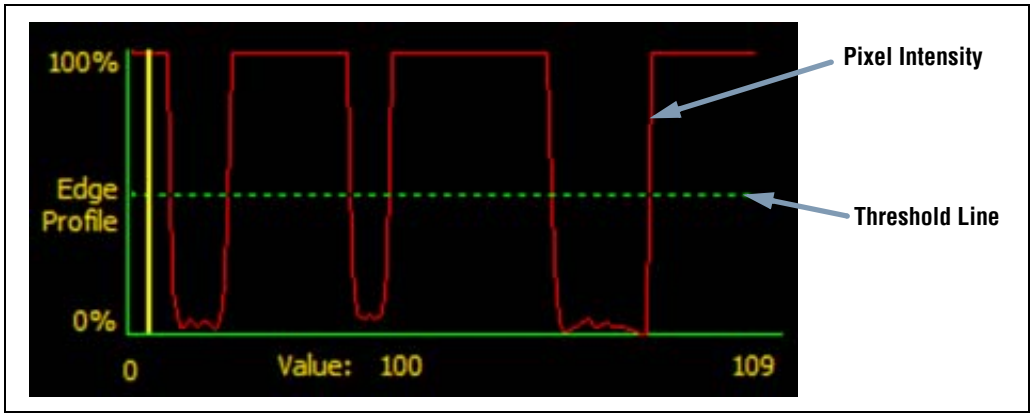
## Threshold Example

The following image shows an Object tool, scanning three bars from left to right.



In the Object tool pixel graph below, the horizontal axis is the position in pixels along the Object tool's linear ROI, and the vertical axis is the brightness level.

The dotted (green on the screen) line crossing the graph through the middle is the threshold. The solid (red on the screen) line is the pixel intensity along the ROI. An edge is found each time the pixel intensity (solid line) crosses the threshold (dotted line).




## More About Absolute and Relative Thresholds

The threshold is used to mark the gray scale transition point. The tool marks the edge when the pixel intensity crosses the threshold level.

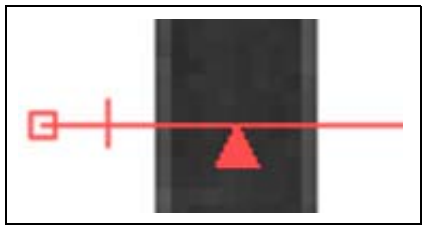
**Absolute Threshold** requires a specific gray scale level to be chosen.

**Relative Threshold** converts the range of gray levels found along the ROI into a percentage of light. The brightest gray scale level is 100% and the darkest is 0%. Choose the percentage value at which the edge should be marked.

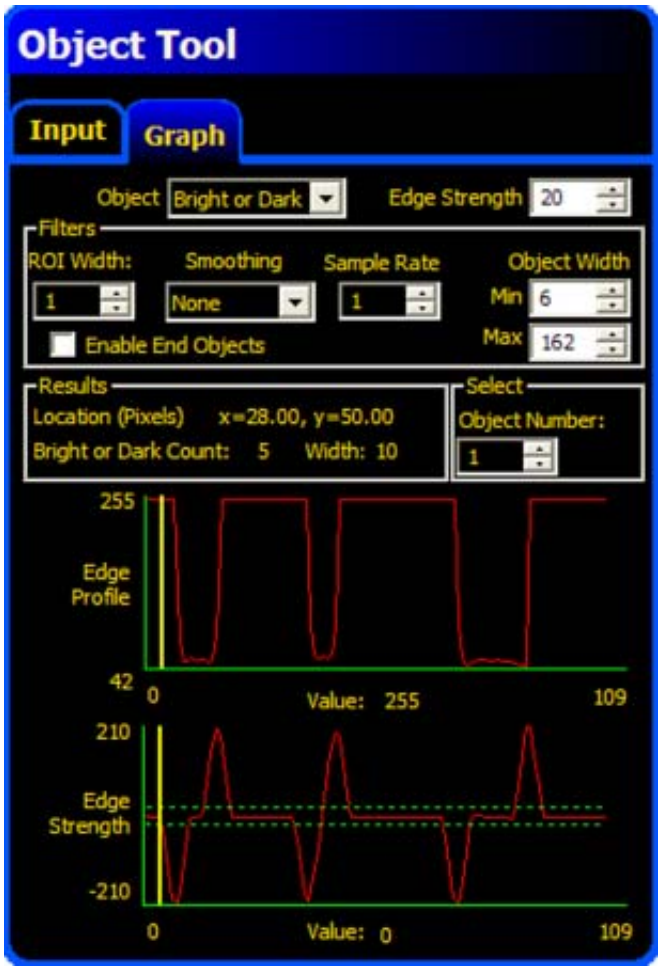
**Edge Strength Threshold** detects the rate of change in gray scale levels. The greater the change, the stronger the edge strength.

## Edge Strength Threshold

Instead of finding edges at a specific fixed-intensity level, Edge-Strength edge detection is gradient-based; that is, it scans for changes in intensity levels along the ROI. The edges are found when the intensity change reaches a specific, set level.



**Example:** The image at left shows how a gradient-based edge is detected. It is a close-up view of the previous Threshold Example screen image.

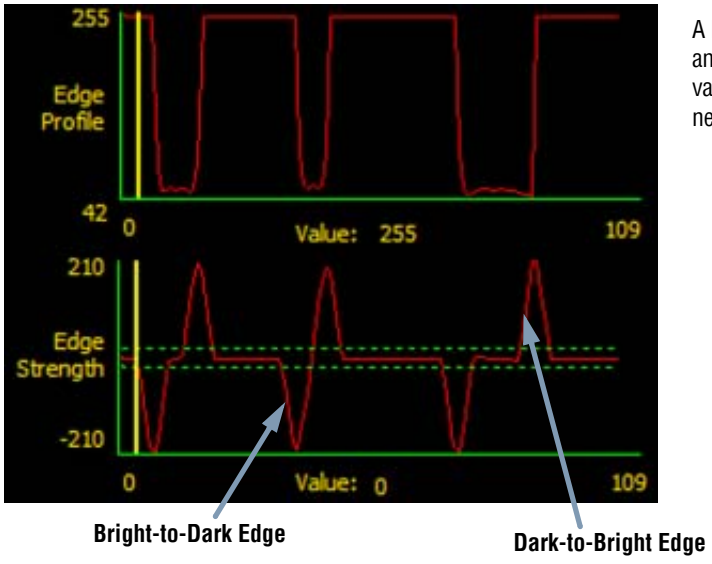



When **Edge Strength** is selected, another tab appears on the tool window. The graph for the previous tab (in this case, the **Input** tab) overlays both the edge strength graph and the edge profile. In the **Graph** tab, the edge profile graph and the edge strength graph are separated for easier viewing.

The top graph in the image at left, **Edge Profile**, represents the absolute gray scale level across the Object tool.

The bottom graph, **Edge Strength**, represents the change in gray scale along the Object tool.

Edge Strength detects an edge when the intensity change (solid red line on the screen) crosses the selected intensity change amount (dashed green lines on the screen).

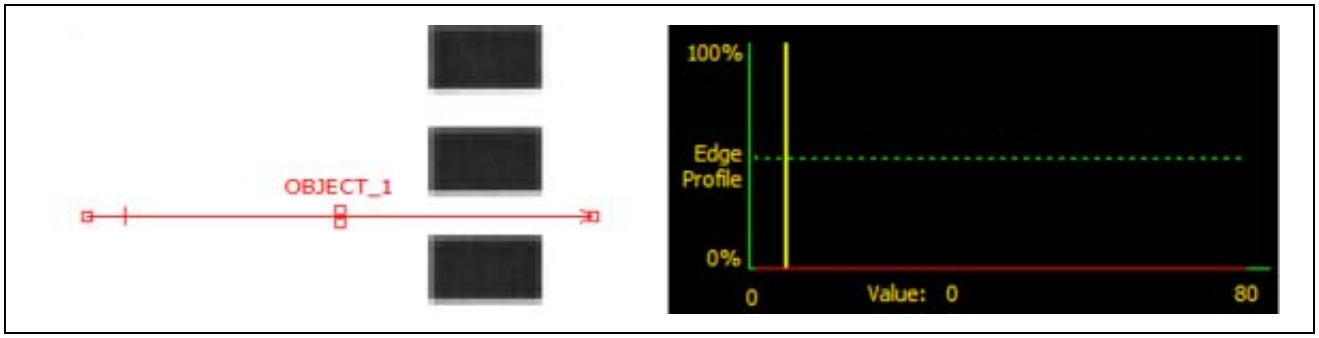



A bright-to-dark transition has a negative edge strength value, and a dark-to-bright transition has a positive edge strength value. When the Edge Strength level is adjusted, both the negative and positive lines will adjust together.

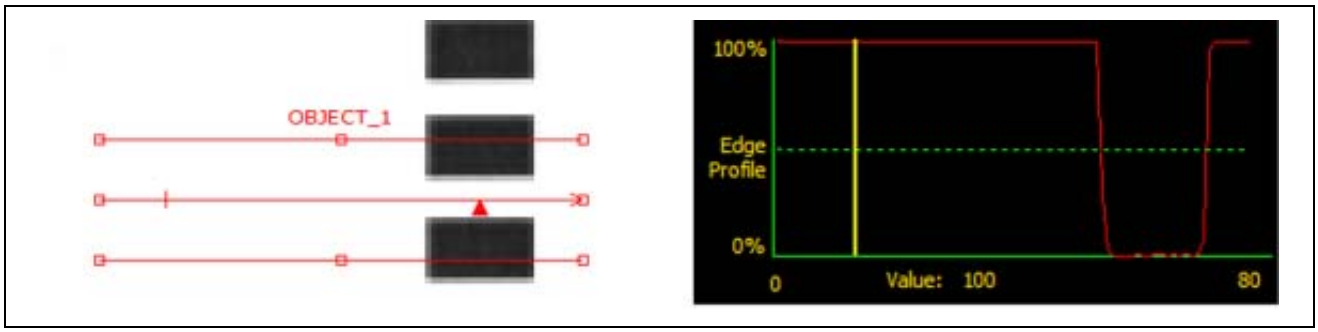
### ROI Width

| | |
|---|---|
| | **ROI Width (default: 1)**<br>- Width can be increased in increments of 4 pixels (1, 5, 9, 13, ...) up to the total FOV size.<br>- Narrow ROIs execute faster but could miss the part (see below).<br>- Wide ROIs are more consistent but don't execute as fast. |

**Example:** The images below show how a narrow ROI could miss the part if the part shifts up or down.




Widening the ROI, as shown below, makes it wide enough to always detect the thin bars. This wider line results in the tool consistently finding the object every time.

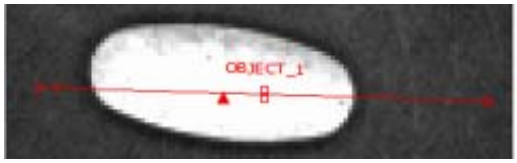



### More About Wide ROIs

If the width of the ROI is greater than 1, the gray scale levels of the pixels are averaged along the width of the ROI. The averaged value helps smooth out jagged edges.

### Object Polarity

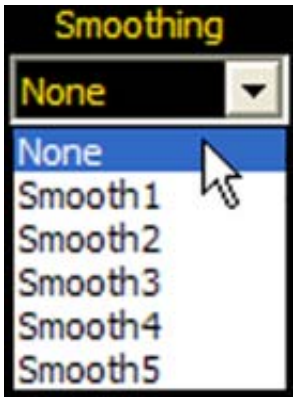
In the following images, the bright object will be found only if **Bright** is selected, and the dark object will be found only if **Dark** is selected. Either object will be found if **Bright or Dark** is selected. Selecting these options is described in Object Polarity (default: Bright or Dark) in the table on page 81.




**Bright Object**

**Dark Object**

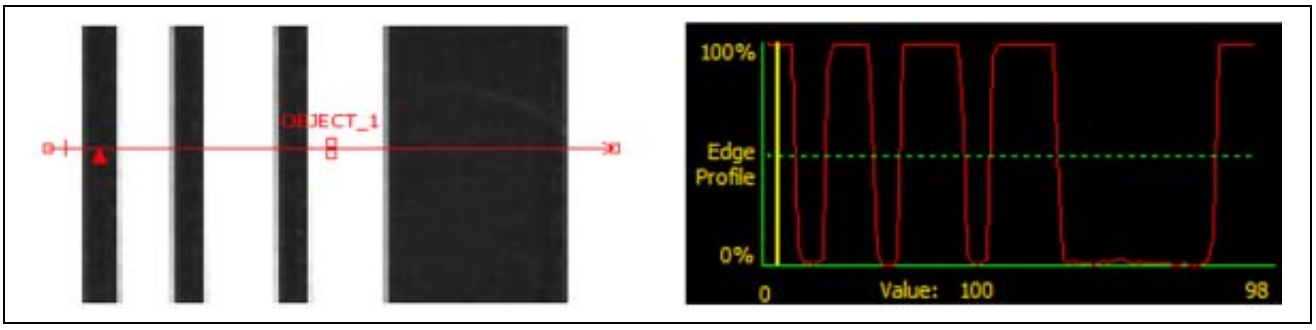
### Smooth Filter



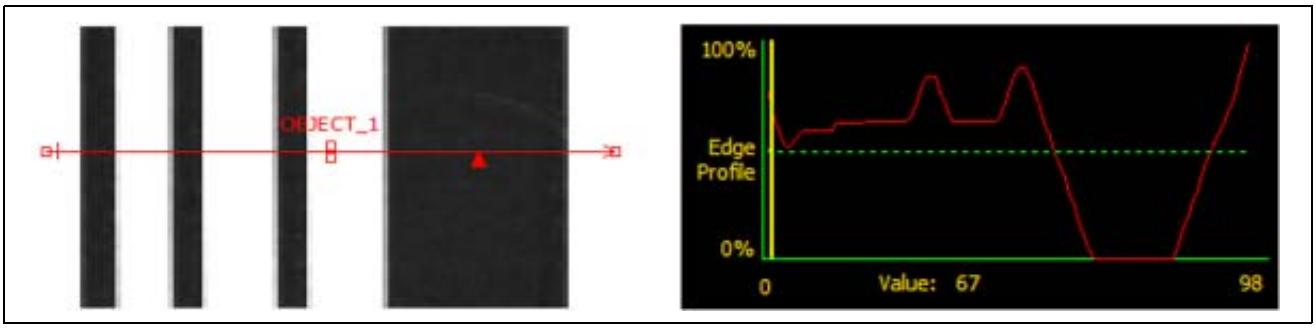

**Smooth Filter (default: None, range: None to 5)**

- Filters out small sharp changes in the edge profile.
- A high filter number may miss the edge of a narrow line.

In the following image, the Smooth filter is not selected, so the Object tool finds the first object with narrow lines.



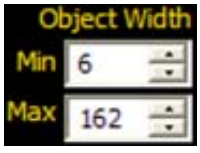

In the following image, the Smooth filter is selected, so the lines act brighter, making thin objects easier to ignore.




### More About the Filter

The smooth filter calculates a rolling average of the object. The rolling average width increases with the smooth number.

### Object Width

| | |
|---|---|
|  | **Minimum and Maximum Width (default: Min. = 6, Max. = 162)**<br>- Filters out objects and spaces that are smaller than the minimum and larger than the maximum. |

### More About Object Width

The minimum and maximum object width affects both objects and spaces between the objects. The following four examples show how the minimum object width can filter out objects and spaces.

In all the examples, the minimum object width is 6 pixels (default), and the polarity is set to dark objects.

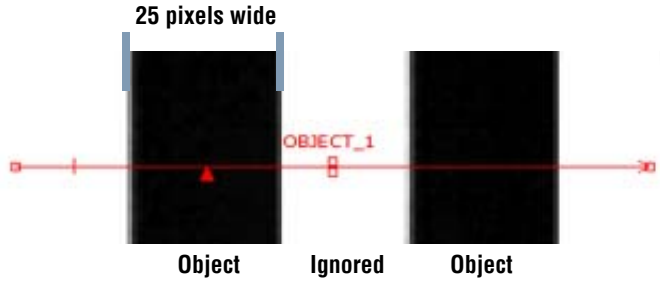
**Example 1:**

Both objects are greater than 6 pixels.

**Found:**

2 dark objects

Space is ignored, because polarity is set to dark objects.



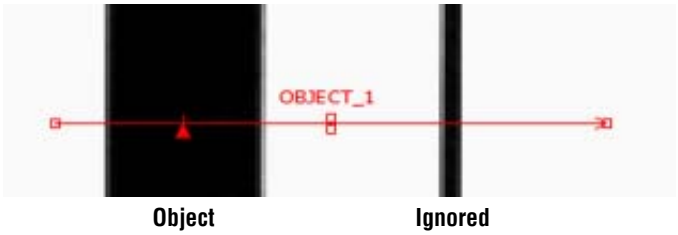

**Example 2:**

One object is less than 6 pixels wide.

**Found:**

1 dark object

Second object, less than 6 pixels wide, is ignored.



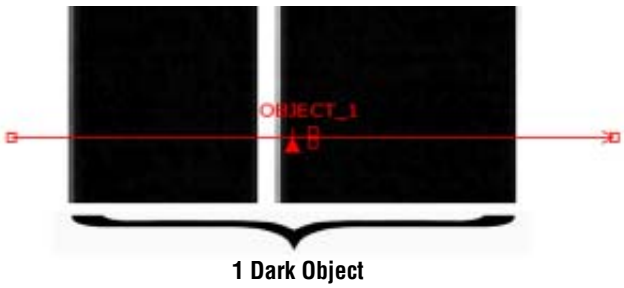

**Example 3:**

Both objects are greater than 6 pixels wide, but the space between them is less than 6 pixels wide.

**Found:**

1 dark object

Because the space was less than 6 pixels wide, the Sensor filters out the space and combines the two dark objects and the space into one large object. This filter is good for ignoring scratches and small shadowing.



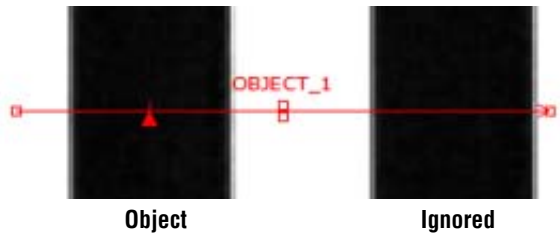

**Example 4:**

The object ends less than 6 pixels from the edge of the Object tool.

**Found:**

1 dark object

An object will be filtered out if the distance from the edge of the object to the end of the Object tool is less than the minimum width. In this example, the minimum width is 6 pixels.



### Sample Rate

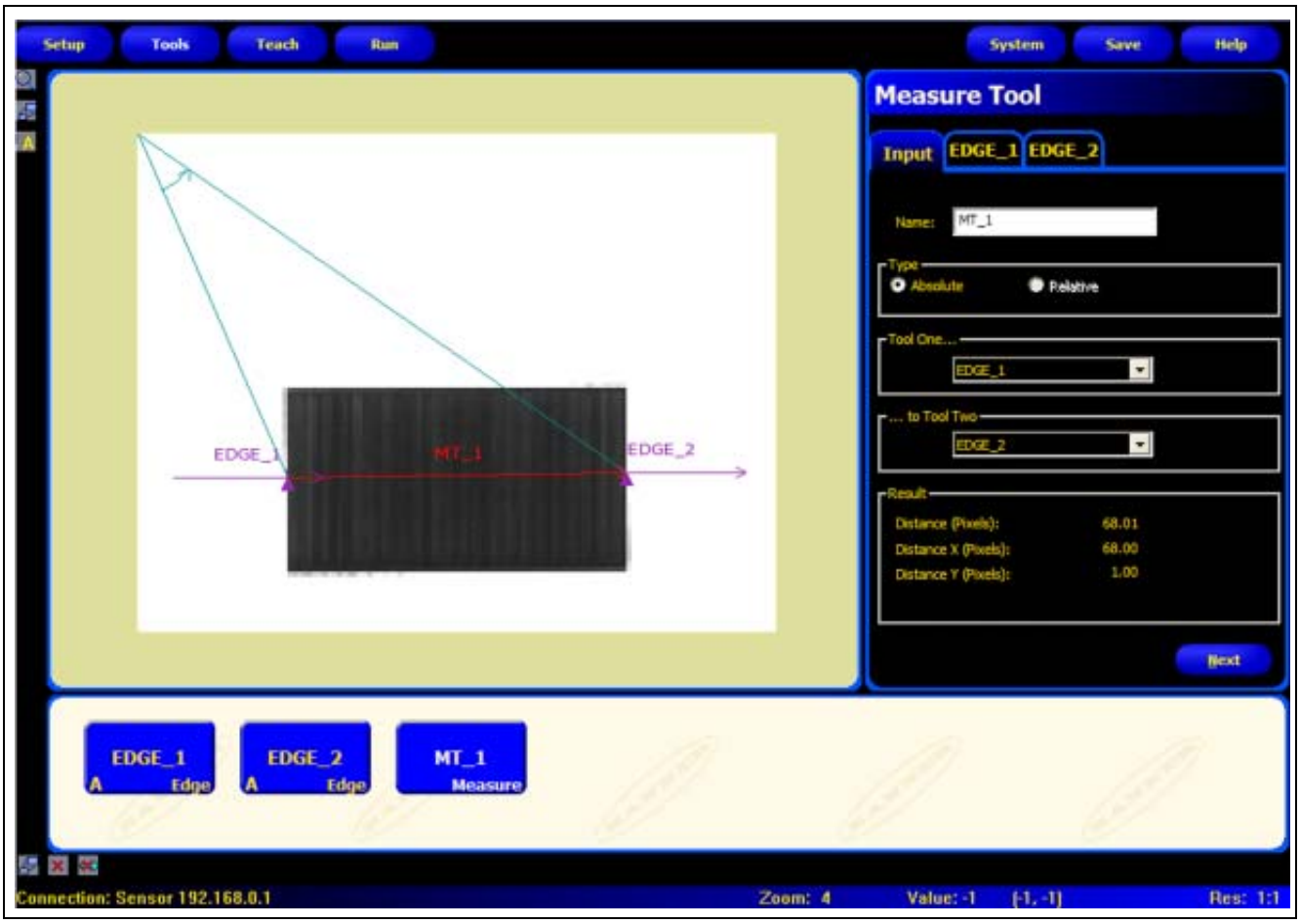
| | |
|---|---|
| | **Sample Rate (default: 1, range: 1–4)**<br>**1** = 1-pixel resolution<br>**2** = 1/2-pixel resolution<br>**3** = 1/3-pixel resolution<br>**4** = 1/4-pixel resolution<br>- Determines the subpixel sampling<br>- Increases the resolution of the tool<br>- Increases the inspection time |

## Object Tool Results

| Name | Value | Description |
|---|---|---|
| Location | pixels (X,Y) | The position of the object midpoint. The origin (0,0) is the upper-left corner of the screen. |
| Current Object | object number | If more than one object is found, use this selector to select an object to analyze. |
| Count | whole number | Total number of Bright, Dark, or All objects (depending on the Bright/Dark option in effect). |
| Width | pixels | Distance between the edges of the current object. |

# Measure Tool Setup

The Measure tool measures the distance between two points found by previous tools; it calculates the distance from one point to another.



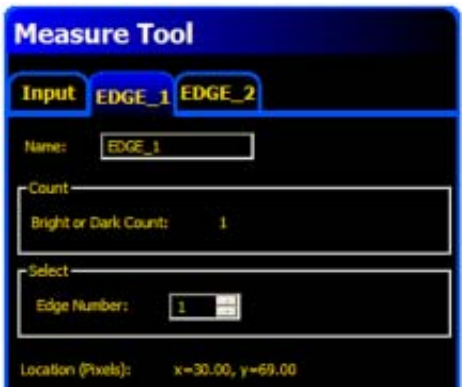

***Measure Tool Distance***

# Measure Tool Configuration

**Measure Tool Examples:**

- Measure part width
- Measure label position
- Detect bent pins

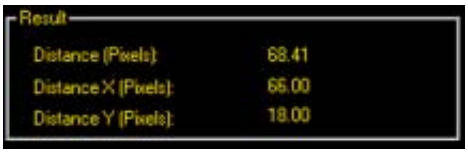
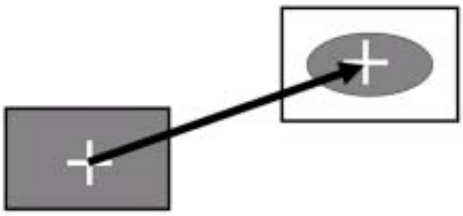
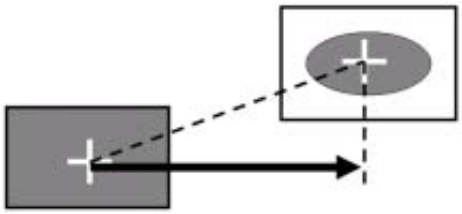
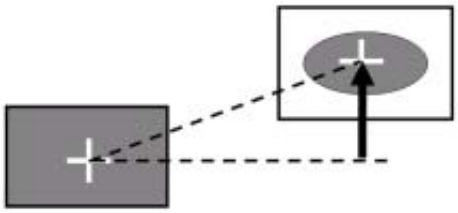
| | |
|---|---|
| | **Name (default: MT_1, MT_2)**<br>- Used to rename the tool.<br>- The name can have only alphanumeric characters or underscores and no spaces. |
| | **Tool Type**<br>**Absolute** is in respect to the origin. **Relative** is in respect to the Location tool. |
| | **Tool One …**<br>Use this option to select the tool that contains the first point of the measurement. After the tool is selected, a tab appears at the top of the window that contains the information from the selected tool.<br>**… to Tool Two**<br>Use this option to select the tool that contains the second point of the measurement. After the tool is selected, a tab appears at the top of the window that contains the information from the selected tool.<br>**More About Tool One and Tool Two**<br>Tools that can find multiple points can be used as Tool One and Tool Two. For example, if an Object tool finds five patterns, the Measure tool can then measure from LOCATE_1, Point 1 to OBJECT_1, Point 4. |




**Tool Tabs**

Tool One and Tool Two have tabs in the Tool window. Clicking on each tool's tab will bring up information for that tool, as shown at left.

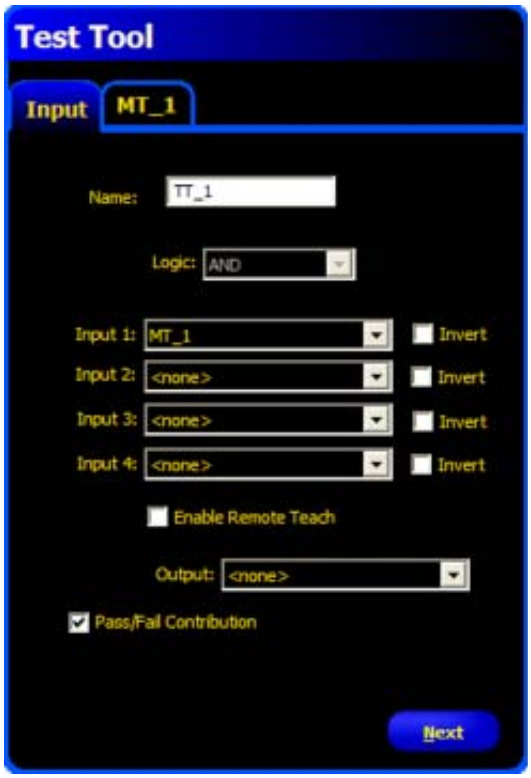
## Measure Tool Results

| Name | Value | Description |
|---|---|---|
|   | Distance<br>Distance X<br>Distance Y | **Distance** (total), **Distance X**, and **Distance Y** are illustrated in the following rows of this table. |
| **Distance**  | Pixels (X,Y) | Distance between the points selected by **Tool One ... ... to Tool Two**. |
| **Distance X**  | Pixels (X) | Horizontal component of the distance between the points selected by **Tool One ... ... to Tool Two**. |
| **Distance Y**  | Pixels (Y) | Vertical component of the distance between the points selected by **Tool One ... ... to Tool Two**. |

# Test Tool Setup

The Test tool is used to set tolerances to the results of the Vision and Analysis tools and to activate the discrete outputs. Typically, these tolerances are set automatically during Quick Teach or Teach. See Teaching an Inspection (in Section 9, Teach) on page 117. They also can be manually set or modified before or after teaching or running the inspection, in which case Quick Teach will discard any manually-entered values. For inspections with many Vision tools, the Test tools can be linked together.

## Test Tool Configuration




**Test tool results can be used as follows:**

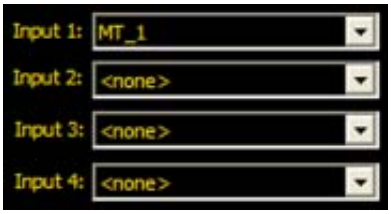
- Gather results from image processing tools and discrete inputs
- Establish parameters for desired inspection results
- Tie multiple results together with logic options
- Include results in the overall Pass/Fail criteria
- Activate an output based on the inspection results

| | |
|---|---|
| | **Name (default: TT_1, TT_2)**<br>- Used to rename the tool.<br>- The name can have only alphanumeric characters or underscores and no spaces. |
| | **Logic (default: AND)**<br>Use logic to combine multiple inputs to the Test tool. The results at the inputs and the logic option selected will determine whether the Test tool is TRUE or FALSE.<br>See the following Examples of Logic Results table. |

The following table shows the Test tool results for various logic functions. For each function, Input 1 and Input 2 are sampled in four different combinations.

***Examples of Logic Results***

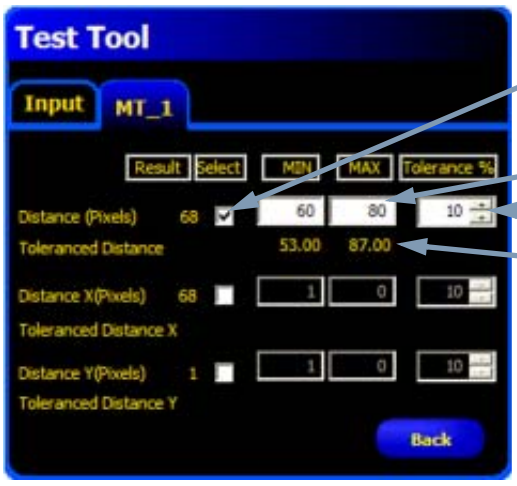
| Logic Function | Input 1 | Input 2 | Test Tool Result | Description |
|---|---|---|---|---|
| AND | FALSE | FALSE | FALSE | Test tool is TRUE when all the inputs are TRUE. |
| | TRUE | FALSE | FALSE | |
| | FALSE | TRUE | FALSE | |
| | TRUE | TRUE | TRUE | |
| OR | FALSE | FALSE | FALSE | Test tool is TRUE when any input is TRUE. |
| | TRUE | FALSE | TRUE | |
| | FALSE | TRUE | TRUE | |
| | TRUE | TRUE | TRUE | |
| XOR | FALSE | FALSE | FALSE | Test tool is TRUE when one and only one input is TRUE. |
| | TRUE | FALSE | TRUE | |
| | FALSE | TRUE | TRUE | |
| | TRUE | TRUE | FALSE | |

| | |
|---|---|
| | **Invert**<br>Inverts the individual input. If the input is TRUE, Invert reverses it to FALSE. If the input is FALSE, Invert reverses it to TRUE. |
|  | **Inputs 1–4 (default: none)**<br>- Choose **previous** tools or external inputs that need to be evaluated to pass the Test tool.<br>- When a tool is chosen, another tab pops up in the window of the tool to be configured.<br>NOTE: The tool to be evaluated **must** appear before the Test tool in the Navigation window. |
| | **Enable Remote Teach (default: unchecked)**<br>Checking the box enables the tool to be taught remotely as explained in Section 10, Remote Teach beginning on page 121. |

***Test Tool Options***

| Tool | Values | Options |
|---|---|---|
| Locate | Not available | |
| Object | Count<br>- Bright object<br>- Dark object<br>- All (bright or dark)<br>Width (pixels)<br>- Bright<br>- Dark | <br>Min/Max<br>Min/Max<br>Min/Max<br><br>Min/Max/Tolerance percent*<br>Min/Max/Tolerance percent* |
| Edge | - Bright-to-dark (edge count)<br>- Dark-to-bright (edge count)<br>- All (edge count) | Min/Max<br>Min/Max<br>Min/Max |
| Measure | Distance (pixels)<br>Distance X (pixels)<br>Distance Y (pixels) | Min/Max/Tolerance percent* |
| Test | TRUE/FALSE value | |
| Communication | Success/Fail | |
| Discrete Inputs 1–6 | ON/OFF | |
| System Error | TRUE/FALSE | |
| * See Tolerance Percent (default: 10) on page 94. | | |

## Example of Toleranced Values




**Check this box to include the parameter in the inspection.**

**Input values**

**Tolerance percent**

**Resulting toleranced values**

NOTE: To make the toleranced values equal the input values, make the Tolerance percent **0**.

**Tolerance Percent (default: 10)**

The Tolerance percent creates a window around the input values of the Test tool. The default value is 10 percent. Then the Sensor adds to both sides of the range a 10 percent buffer of the taught or manually-entered range. **Adjust the Tolerance percent before teaching to customize the acceptable window.** See the following Tolerance Percent Formula and Example.

### Tolerance Percent Formula:

The software uses this formula to calculate each **Toleranced Distance**, shown previously.

$$\text{Toleranced Minimum} = \text{Min(R)} - \left(\frac{\text{Max(R)} + \text{Min(R)}}{2}\right) \times \frac{\text{Tolerance}}{100}$$

$$\text{Toleranced Maximum} = \text{Max(R)} + \left(\frac{\text{Max(R)} + \text{Min(R)}}{2}\right) \times \frac{\text{Tolerance}}{100}$$

### Tolerance Percent Example:

The example at right uses the formula above and the values entered for **Distance (Pixels)** in the **MT_1** tab shown previously.

Taught Range = 60 to 80 pixels
Taught Min(R) = 60
Taught Max(R) = 80
Tolerance = 10%

$$\text{Toleranced Minimum} = 60 - \left(\frac{80 + 60}{2}\right) \times \frac{10}{100} = 53.00$$

$$\text{Toleranced Maximum} = 80 + \left(\frac{80 + 60}{2}\right) \times \frac{10}{100} = 87.00$$

## Test Tool Results

| | |
|---|---|
| | **Output (default: none)**<br>Choose an available General Output to activate if the Test tool is TRUE.<br>NOTE: If a discrete output is not available, choose **System** in the Main Menu toolbar, then click on the **InputOutput** tab. Discrete I/O set up as inputs will not show up in the Output Options box. See the System Setup window (in Section 12, System Setup) on page 136 for more information. |
| | **Pass/Fail Contribution (default: checked)**<br>- Check this box if the Test tool will influence the Pass/Fail status of the inspection.<br>- Do not check this box if the overall Pass/Fail status of the inspection is not dependent on the current Test tool.<br>- The Pass/Fail contribution influences the following:<br>  - Discrete output Pass<br>  - Discrete output Fail<br>  - Pass/Fail results counter<br>  - Pass (Green) and Fail (red) LEDs on the Sensor<br>  - Freezing an image on the video monitor<br>  - Display options on the PC |

# Communication Tool Setup

The Communication tool is used to conditionally export data from the Sensor to an external device. Results from the Vision tools may be selected by the Communication tool and exported to an external device. The Sensor can export data over the Ethernet or via its serial channels. See Ethernet Communication Channel Specifications below.

**Examples of results exported by the Communication tool:**

- Execution times
- Whole-number counts
- Input and output values from Test tool
- Success rates from Locate tool, Vision tools, and Test tools
- Reference point-to-edge and rotation distances

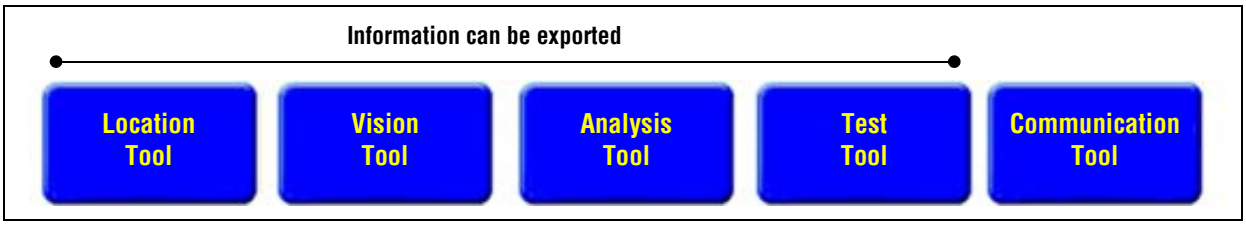
## Ethernet Communication Channel Specifications

The Sensor can export data over the Ethernet. The tables below provide specifications for the communications channels.

| Attribute | Specification |
|---|---|
| Network Protocol | TCP/IP<br>NOTE: The Sensor places ASCII strings inside the TCP/IP packets without any additional protocols, just as if they were being transmitted over a serial line. |
| Communication Protocol | ASCII |
| Connection | RJ-45 (10 TCP sockets) |
| Speed | 10/100 Base-T |

# Adding a Communication Tool

| | |
|---|---|
| **IMPORTANT** | Add the Communication tool **AFTER** the Vision tools that have data to be exported. |




***Tool Navigation***

As shown above, the Communication tool can export results data from the first Location, Vision, Analysis, and Test tools as follows:

- In the sequence that the tools are selected within the Communication tool
- In the sequence that the options are listed within the tools for export

### One inspection can have more than one Communication tool.

Use one Communication tool to:

- Export data out of one port (serial or Ethernet).
- Export identical data out of multiple ports at the same time.

Use multiple Communication tools to:

- Separate the data and export separate segments to unique external devices.
- Customize the order of the exported data.
- Export data from the Vision tools at different times during the inspection.
- Customize the "Start Strings" control characters to unique external devices.

NOTE: The Test tool can have the Communication tool as one of its inputs. Therefore, if a Test tool is added after the Communication tool, a discrete output can be activated:

a) if the TCP/IP connection is lost, or

b) if the external device fails to acknowledge it received data.

This output could contribute to an inspection Pass/Fail if it is an input to a Test tool. A Communication tool without a Test tool will not contribute to the inspection Pass/Fail.

# Configuring the Communication Tool

There are four main steps in configuring the Communication tool:

**A. Select the Vision tools and their results to export.**
See below.

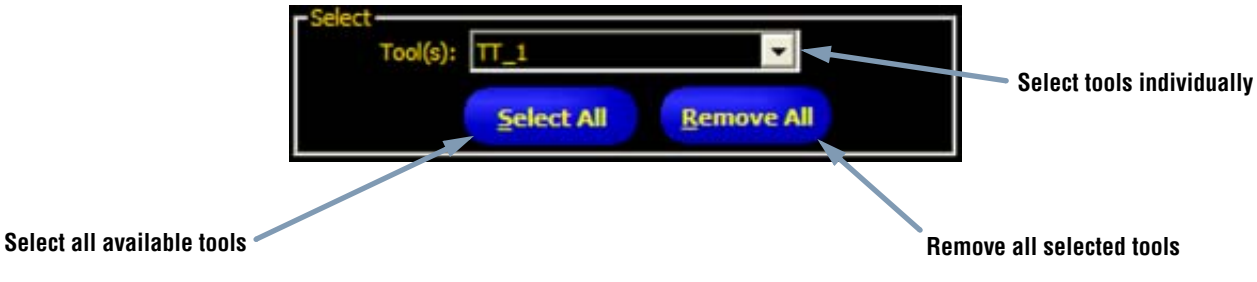
**B. Select the communication connection(s) that will export the data.**
See B. Select the Connection(s) on page 99.

**C. Format the ASCII string of data.**
See C. Format the ASCII String on page 101.

**D. Select to conditionally export the selected data.**
See D. Conditionally Export Selected Data on page 103.

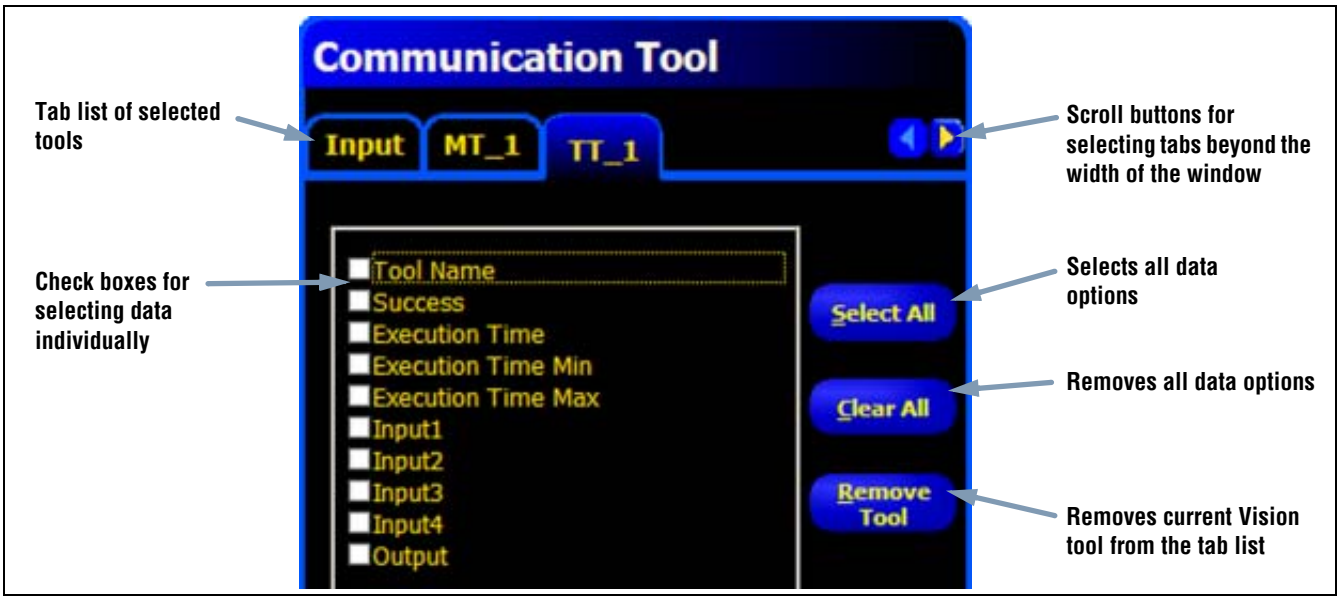
***Communication Tool***

## A. Select the Vision tools and Their Results



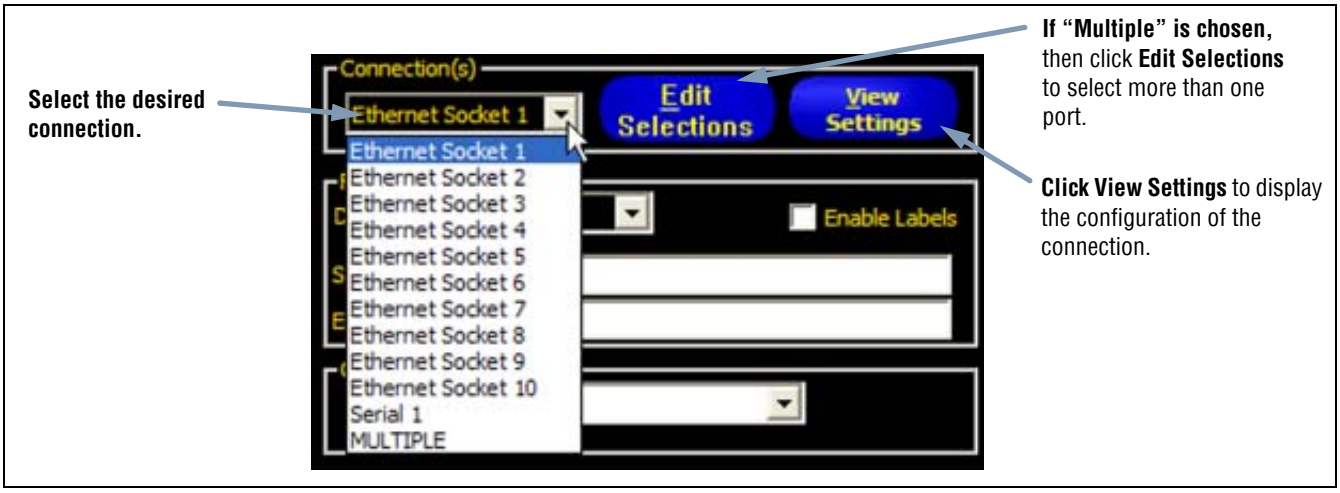

***Select Options***

When a tool is selected, a tab appears at the top of the window. Click on the tab to select the data to be exported.



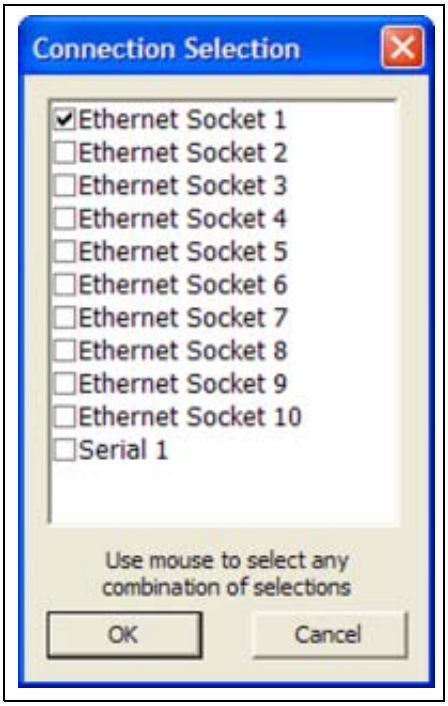

***Test Tool Data in the Communication Tool***

## B. Select the Connection(s)



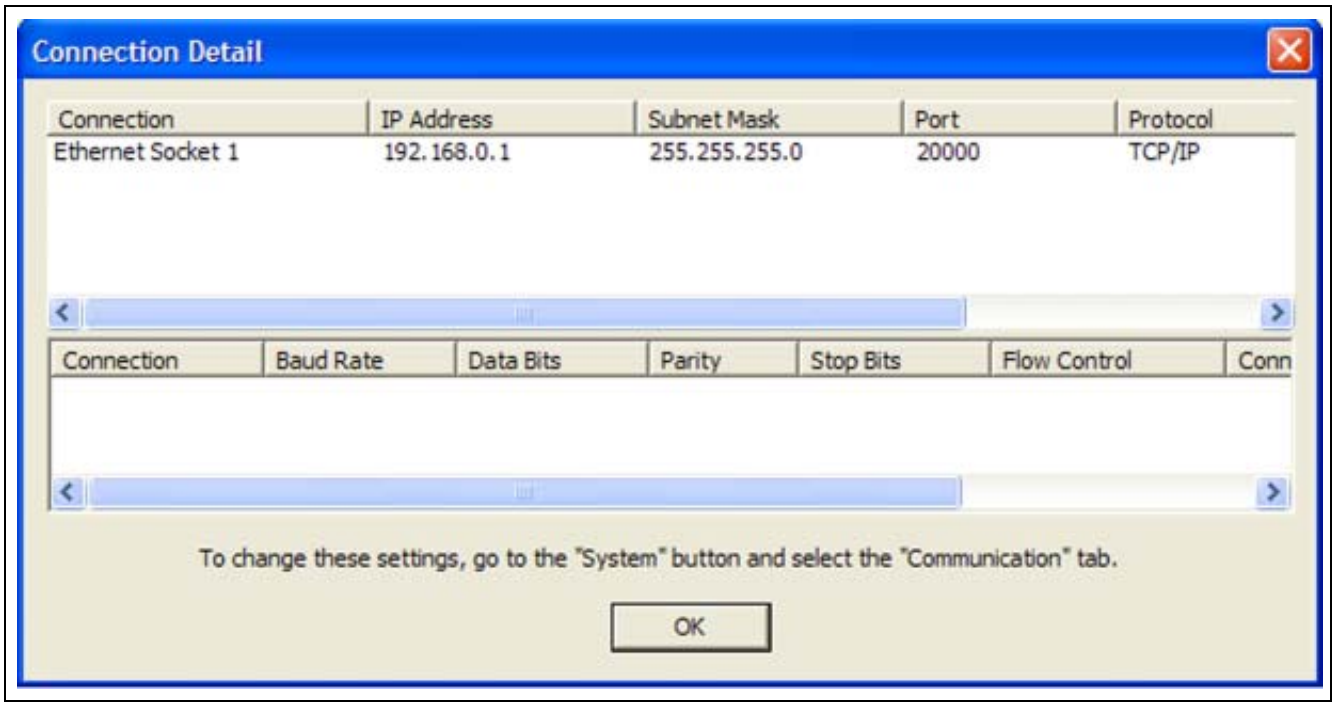

***Connection Options***

When **Multiple** is chosen, click **Edit Selections** to select more than one port. The Connection Selection window will pop up. Check the desired ports, as shown by the checked boxes below.




***Connection Selection Window***

Clicking **View Settings** pops up the Connection Detail window.




***Connection Detail Window***

Data can be sent through 11 different communication connections: one connector for the serial connection, and 10 sockets (1 to 10) through the Ethernet connector.

The 10 Ethernet sockets are comprised of the Sensor IP address and port number. The table below lists the default Ethernet socket addresses:

| Socket | Default IP Address | Port |
|---|---|---|
| 1 | 192.168.0.1 | 20,000 |
| 2 | 192.168.0.1 | 20,001 |
| 3 | 192.168.0.1 | 20,002 |
| 4 | 192.168.0.1 | 20,003 |
| 5 | 192.168.0.1 | 20,004 |
| 6 | 192.168.0.1 | 20,005 |
| 7 | 192.168.0.1 | 20,006 |
| 8 | 192.168.0.1 | 20,007 |
| 9 | 192.168.0.1 | 20,008 |
| 10 | 192.168.0.1 | 20,009 |

The serial port is the RS-232 connector (Pins 1 and 11) on the Sensor. The default settings for the serial port are listed in the table below.

| Attribute | Default Setting |
|---|---|
| Baud Rate | 115200 |
| Data Bits | 8 |
| Parity | None |
| Stop Bit | 1 |
| Flow Control | None |

For more information about configuring the Ethernet and Serial connections, see Communication Tab (in Section 12, System Setup) on page 139.

## C. Format the ASCII String

Use this section to select delimiters, enable labels, and define a Start and/or End string.

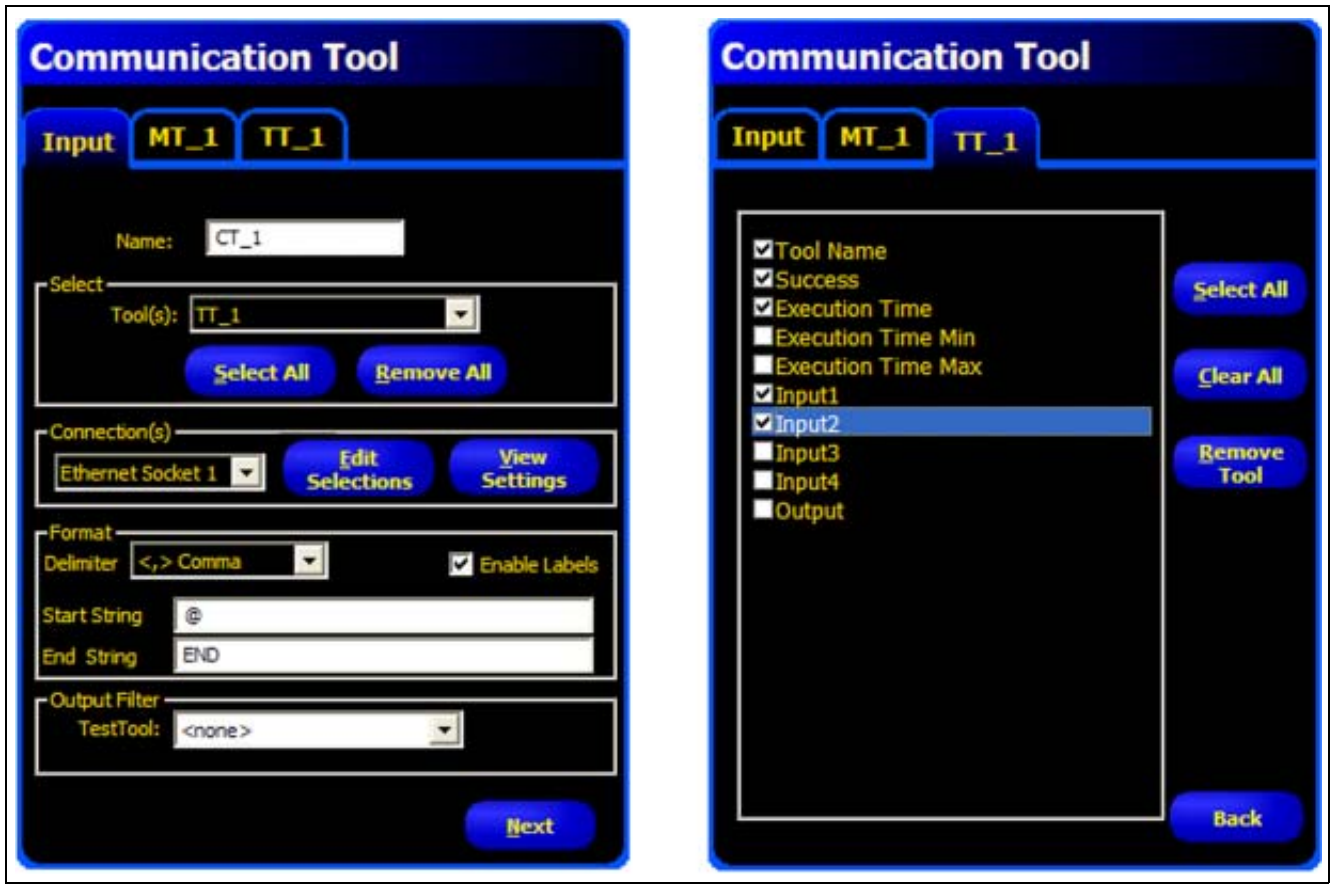
***Format Options***

Allowable ASCII string options are given in the following table:

***ASCII String Format Options***

| Option Name | Values | Description |
|---|---|---|
| Delimiter | Comma ,<br>Colon :<br>Semicolon ;<br><cr-lf> Carriage return and then line feed<br><lf-cr> Line feed and then carriage return<br><cr> Carriage return only<br><lf> Line feed only | The delimiter is used to separate the individual pieces of data being sent. The delimiter will follow every individual segment of data, including the start string and end string. |
| Start String | User-defined ASCII characters (limit of 75 characters) | This option allows the user to add characters before the string of data. |
| End String | User-defined ASCII characters (limit of 75 characters) | This option allows the user to add characters after the string of data. |
| Enable Labels | Parameter labels | Check this box to add a label to the data before the data itself. Example: Dark Count = 3. ("Dark Count = " is the label) |

See the Format Example illustration below.




***Format Example***

From the screens shown in the preceding Format Example, the Communication tool will export the following:

- Tool name
- Success flag
- Execution time
- Input 1
- Input 2
- A comma (,) delimiter
- The data labels
- @ at the start of the string and "END" at the end of the string

### D. Conditionally Export Selected Data

The Output Filter allows for specific output selections in order to avoid unwanted output information.

- Select **Pass** to export the selected information on passing Test tools.
- Select **Fail** to export the selected information on failing Test tools.

## Communication Tool Results

The Communication tool will send out the data in the same sequence that the tools appear in the inspection. The transmission of data will increase the total inspection time.

The table below shows the data that will be sent out for each tool:

***Communication Tool Results***

| Result | Value | Description |
|---|---|---|
| Success | 1 = The connection is valid, and data will be sent.<br>0 = The connection was lost. | Checks the connection (Ethernet only). |
| Execution time | Given in ms. | Processing time for the Sensor to send the data out. |

The table below shows the format of the data:

***Format of the Data***

| Result* | Number | Format | Example |
|---|---|---|---|
| Point (X, Y) | Decimal | (00.00, 00.00) | (23.41, 156.52) |
| Distance | Decimal | 00.00 | 99.00 |
| Count | Whole | 0 | 4 |
| Area | Whole | 0 | 12300 |
| * Available data is model-dependent. | | | |

# Available Results to Export

***Communication Tool Exportable Results***

| Tool | Data Label | Value | Example | Description |
|---|---|---|---|---|
| **Locate** | Tool Name | string | LOCATE_1 | User-defined name. |
| | Success | 1 or 0 | 1 | 1 = Tool executed successfully.<br>0 = Tool did not find a point to use as a reference. |
| | Execution Time | ms | 1.4 | Tool processing time for the current inspection. |
| | Execution Time Min | ms | 1.4 | Fastest recorded tool processing time since the start of the inspection or since power-up. |
| | Execution Time Max | ms | 1.6 | Slowest recorded tool processing time since the start of the inspection or since power-up. |
| | Edge Offset Point | pixels (X, Y) | (–0.11, 4.11) | Distance from the reference edge to the current edge. |
| | Edge Location Point | pixels (X, Y) | (140.89, 49.11) | X, Y coordinates of the current edge. |
| | Rotation | degrees | –16.52 | Amount of rotation from the current edge to the reference edge. |
| | Rotation Origin | pixels (X, Y) | (140.89, 49.11) | X, Y coordinates of the point from which ROIs will rotate. |
| **Edge** | Tool Name | string | EDGE_1 | User-defined name. |
| | Execution Time | ms | 1.7 | Tool processing time for the current inspection. |
| | Execution Time Min | ms | 1.6 | Fastest recorded tool processing time since the start of the inspection or since power-up. |
| | Execution Time Max | ms | 1.7 | Slowest recorded tool processing time since the start of the inspection or since power-up. |
| | Bright-to-Dark Count | whole number | 9 | Total number of bright-to-dark edges. |
| | Dark-to-Bright Count | whole number | 10 | Total number of dark-to-bright edges. |
| | Total Edge Count | whole number | 19 | Total number of all edges. |
| | Location(s) | pixels (X, Y) | (527.53, 348.17) | X, Y coordinates of all the edges found. |

### *Communication Tool Exportable Results*

| Tool | Data Label | Value | Example | Description |
|---|---|---|---|---|
| **Object** | Tool Name | string | OBJECT_1 | User-defined name. |
| | Execution Time | ms | 2.9 | Tool processing time for the current inspection. |
| | Execution Time Min | ms | 2.9 | Fastest recorded tool processing time since the start of the inspection or since power-up. |
| | Execution Time Max | ms | 3.4 | Slowest recorded tool processing time since the start of the inspection or since power-up. |
| | Bright Count | whole number | 2 | Total number of bright objects. |
| | Dark Count | whole number | 2 | Total number of dark objects. |
| | Total Object Count | whole number | 4 | Total number of all objects. |
| | Min Bright Object Width | pixels | 6 | Width of the smallest bright object found. |
| | Max Bright Object Width | pixels | 155 | Width of the largest bright object found. |
| | Min Dark Object Width | pixels | 6 | Width of the smallest dark object found. |
| | Max Dark Object Width | pixels | 7 | Width of the largest dark object found. |
| | Width(s) | pixels | 155.00, 7.00, 6.00, 6.00, 6.00 | Widths of all the objects found. |
| | Location(s) | pixels (X, Y) | (226.26, 270.15) | Midpoint position of all the objects found. |
| **Measure** | Tool Name | string | MT_1 | User-defined name. |
| | Execution Time | ms | 0.1 | Tool processing time for the current inspection. |
| | Execution Time Min | ms | 0.1 | Fastest recorded tool processing time since the start of the inspection or power-up. |
| | Execution Time Max | ms | 0.2 | Slowest recorded tool processing time since the start of the inspection or power-up. |
| | Distance | pixels | 170.14 | Total distance from the points selected for Tool One and Tool Two. |
| | Distance X | pixels | 128.51 | Horizontal component (X) of the total distance. |
| | Distance Y | pixels | 111.51 | Vertical component (Y) of the total distance. |
| | Origin Point | pixels (X, Y) | (0.00, 0.00) | X, Y coordinates of the origin point. |
| | Measure Location Point 1 | pixels (X, Y) | (140.89, 49.11) | X, Y coordinates of the point selected for Tool One. |
| | Measure Location Point 2 | pixels (X, Y) | (269.40, 160.62) | X, Y coordinates of the point selected for Tool Two. |

***Communication Tool Exportable Results***

| Tool | Data Label | Value | Example | Description |
|---|---|---|---|---|
| **Test** | Tool Name | string | TT_1 | User-defined name. |
| | Success | 1 or 0 | 1 | 1 = Tool overall results passed.<br>0 = Tool overall results failed. |
| | Execution Time | ms | 0.1 | Tool processing time for the current inspection. |
| | Execution Time Min | ms | 0.1 | Fastest recorded tool processing time since the start of the inspection or power-up. |
| | Execution Time Max | ms | 0.1 | Slowest recorded tool processing time since the start of the inspection or power-up. |
| | Input1 | 1, 0, or –1 | 1 | 1 = Input 1 results passed.<br>0 = Input 1 results failed.<br>–1 = Input 1 results not defined. |
| | Input2 | 1, 0, or –1 | 1 | 1 = Input 2 results passed.<br>0 = Input 2 results failed.<br>–1 = Input 2 results not defined. |
| | Input3 | 1, 0, or –1 | –1 | 1 = Input 3 results passed.<br>0 = Input 3 results failed.<br>–1 = Input 3 results not defined. |
| | Input4 | 1, 0, or –1 | –1 | 1 = Input 4 results passed.<br>0 = Input 4 results failed.<br>–1 = Input 4 results not defined. |
| | Output | 1 or 0 | 1 | 1 = Tool overall results passed.<br>0 = Tool overall results failed. |

# 8. Exporting with the Communication Tool

This section explains how the Communication tool is used to export data from the Sensor to an external device.

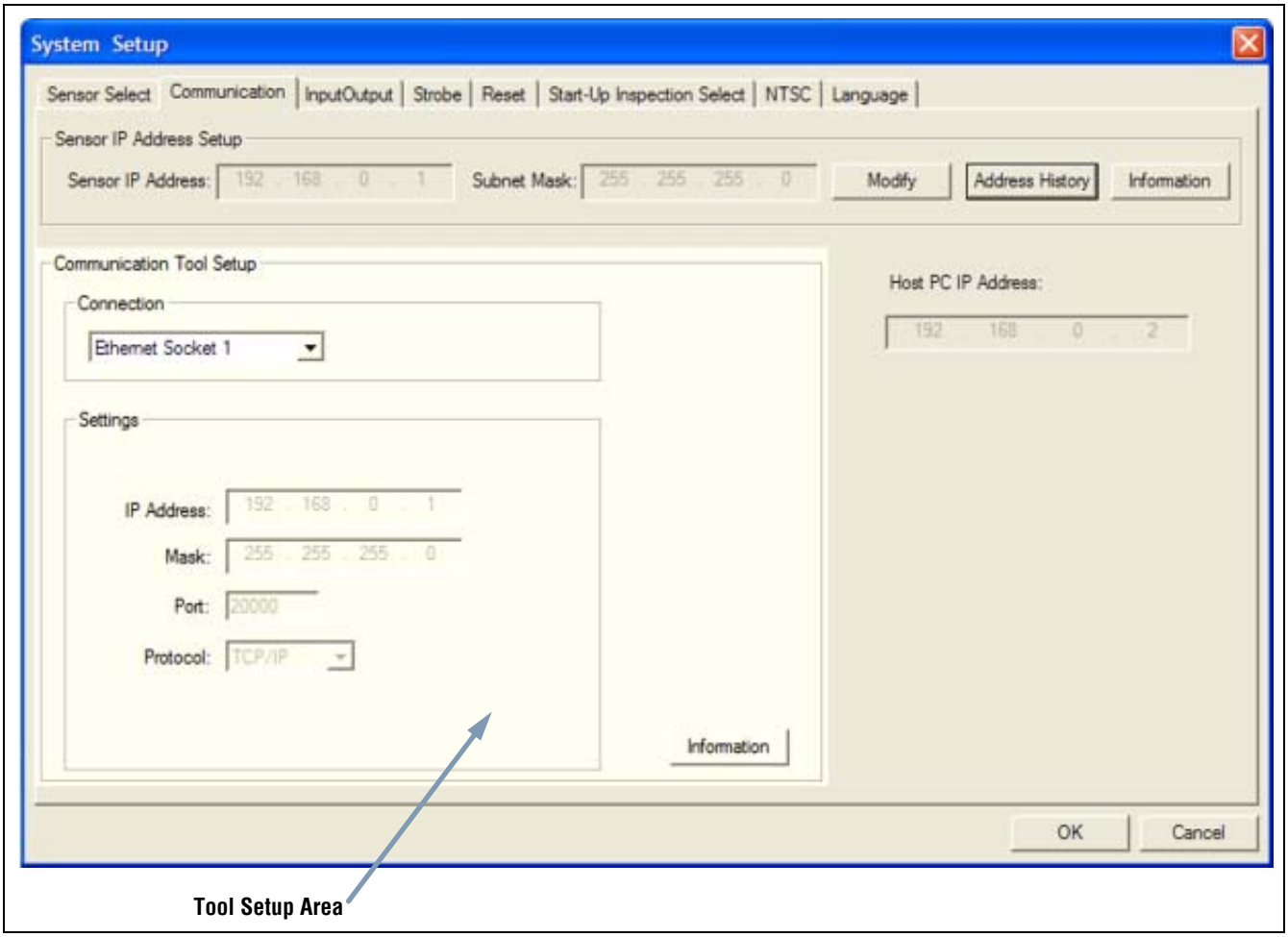
Communication Tab in the System Setup Window . . . . . 108
Ethernet Connection . . . . . 108
Serial Connection . . . . . 109
Testing the Connection . . . . . 110
Basic Steps for Testing the Communication Tool . . . . . 110
Detailed Steps for Testing the Communication Tool . . . . . 110
Troubleshooting Tips . . . . . 112
Ethernet Connection . . . . . 112
Serial Connection . . . . . 112

# Communication Tab in the System Setup Window

For Communication tool setup, click on the **System** button in the Main Menu toolbar to bring up the System Setup window, then click on the **Communication** tab.

## Ethernet Connection

In order to establish a connection, the external device must be directed to the correct IP address and the correct TCP port. In TCP/IP protocol, a TCP port number is used with the IP address to identify a specific path or socket. The Sensor has sockets 1 to 10; therefore, it can send out unique sets of data to 10 different devices.




***Communication Tool Setup, Ethernet***

NOTE: The TCP/IP setup is automatically configured; the Ethernet Settings box is for information purposes only.

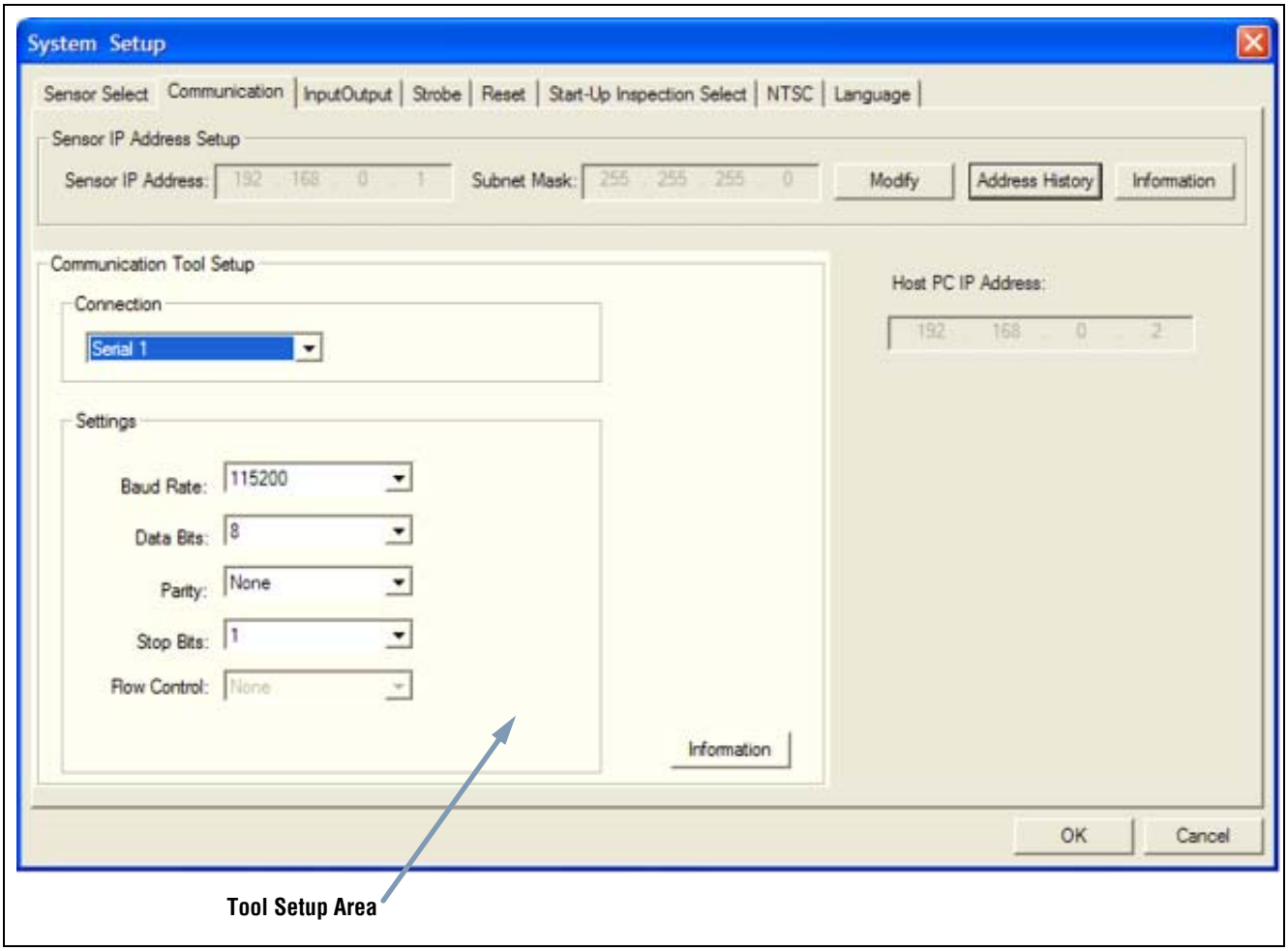
Each Ethernet Socket has a unique TCP port number, as shown in the following table.

***TCP Port Numbers***

| Ethernet Socket | Default IP Address | TCP Port Numbers | | Ethernet Socket | Default IP Address | TCP Port Number |
|---|---|---|---|---|---|---|
| 1 | 192.168.0.1 | 20000 | | 6 | 192.168.0.1 | 20005 |
| 2 | 192.168.0.1 | 20001 | | 7 | 192.168.0.1 | 20006 |
| 3 | 192.168.0.1 | 20002 | | 8 | 192.168.0.1 | 20007 |
| 4 | 192.168.0.1 | 20003 | | 9 | 192.168.0.1 | 20008 |
| 5 | 192.168.0.1 | 20004 | | 10 | 192.168.0.1 | 20009 |

## Serial Connection

The Sensor has one serial connection that can be configured: Serial 1 is Pins 1, 9, and 10.




***Communication Tool Setup, Serial Connection***

Set up the serial communication options to match the receiving device. The following table shows the configuration options:

***Communication Tool Configuration Options***

| Option | Value | Default |
|---|---|---|
| Baud Rate | 110 to 115200 bps | 115200 |
| Data Bits | 5, 6, 7, 8 | 8 |
| Parity | Even, Odd, None, Mark, Space | None |
| Stop Bits | 1, 1.5, 2 | 1 |
| Flow Control | None | None |

NOTE: Because there is no flow control for the serial connections, the Sensor will not detect or log a lost or broken connection.

# Testing the Connection

## Basic Steps for Testing the Communication Tool

1. Connect the Sensor to a PC using a crossover Ethernet cable (STPX..) or the serial pins on the Sensor cable.
2. Start an inspection that has a configured Communication tool. For details about configuring the Communication tool, see Configuring the Communication Tool (in Section 7, Tools) on page 98.
3. Start HyperTerminal or Telnet (see below).
4. Trigger the Sensor.
5. Look in HyperTerminal or Telnet to see if the data has updated.

## Detailed Steps for Testing the Communication Tool

Various software programs can test the communication connection. Two such programs are Telnet and HyperTerminal:

- Telnet can test Ethernet communications and is easy to set up.
- HyperTerminal can test serial communications and Ethernet communications.

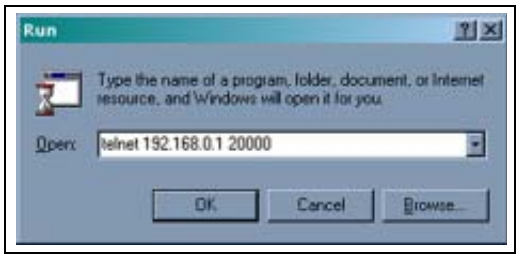
  NOTE: HyperTerminal for Windows NT does not have an Ethernet option.

### Testing Ethernet Communications with Telnet

1. Start an inspection that has a configured Communication tool.
2. Connect a PC to the Sensor using an Ethernet crossover cable.
3. From the Start menu, Click **Start** > **Run**.
4. Type in the dialog box

   **telnet <Sensor IP address> <IP port>** (see Telnet Command Window on page 111).

   Example: telnet 192.168.0.1 20000
5. Click **OK** to open a Telnet window.
6. Trigger the Sensor.
7. View the results.



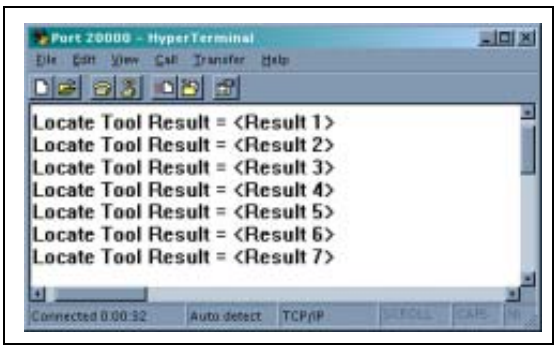

***Telnet Command Window***

### Testing Ethernet or Serial Communications with HyperTerminal

The following table provides HyperTerminal testing instructions for both Ethernet and Serial communications.

***HyperTerminal Testing for Ethernet and Serial***

| | Ethernet | Serial |
|---|---|---|
| **1.** | Start an inspection that has a configured Communication tool. | |
| **2.** | Connect a PC to the Sensor using an Ethernet crossover cable. | Connect a PC to the Sensor using a serial cable. |
| **3.** | Start a new connection with HyperTerminal. | |
| **4.** | Connect using TCP/IP (Winsock). | Connect using COM1 (choose a serial COM port). |
| **5.** | Configure HyperTerminal to talk with the Sensor.<br>Example:<br>- Host Address = 192.168.0.1 (Sensor default)<br>- Port number = 20000 (Ethernet Socket 1) | Configure HyperTerminal to talk with the Sensor.<br>Example:<br>- Baud rate = 115200 bits/sec (Sensor default)<br>- Data bits = 8 (Sensor default)<br>- Parity = None (Sensor default)<br>- Stop bits = 1 (Sensor default)<br>- Flow control = None<br>NOTE: The Sensor settings must match exactly with the PC. |
| **6.** | Trigger the Sensor. | |
| **7.** | View the results. | |




***Sample HyperTerminal Run Time Results***

# Troubleshooting Tips

Refer to the following troubleshooting tips when not receiving data from the Sensor.

## Ethernet Connection

1. Check the LEDs on the Sensor's RJ-45 connector.
   - No LEDs are ON: The cable may not be the correct type (straight or crossover), or it could be broken.
   - Only the yellow LED is ON: The electrical connection is good, but the Sensor and device are not exchanging data.
   - The yellow LED is ON, and the Green LED is ON or flashing: Data is being exchanged between the PC and the Sensor.
2. Verify that the Communication tool is configured correctly.
   - The connection should be Ethernet socket 1–10.
   - Verify that the desired result data has been selected in the **Tool** tab.
3. Check the receiving device setup.
   - Check the IP address. The device IP subnet must match the Sensor IP subnet.
   - Check the Port number: 20000 – 20009 (not 2000). See the TCP Port Numbers table on page 109.
   - Check all firewall or anti-virus software to verify that it is not blocking the Sensor's Ethernet socket.

## Serial Connection

1. Verify the hardware.

   Check for breaks in the serial connection.
2. Check the Communication tool to see if it is configured correctly.

   Verify that the desired result data has been checked.
3. Check the receiving device setup.

   Check that the COM port properties on the receiving device matches the System parameters in the Sensor (baud rate, data bits, parity, stop bits, flow control). See the Communication Tool Setup, Serial Connection screen on page 109.

# 9. Teach

This section explains setting judgment tolerances by teaching inspections on good product.

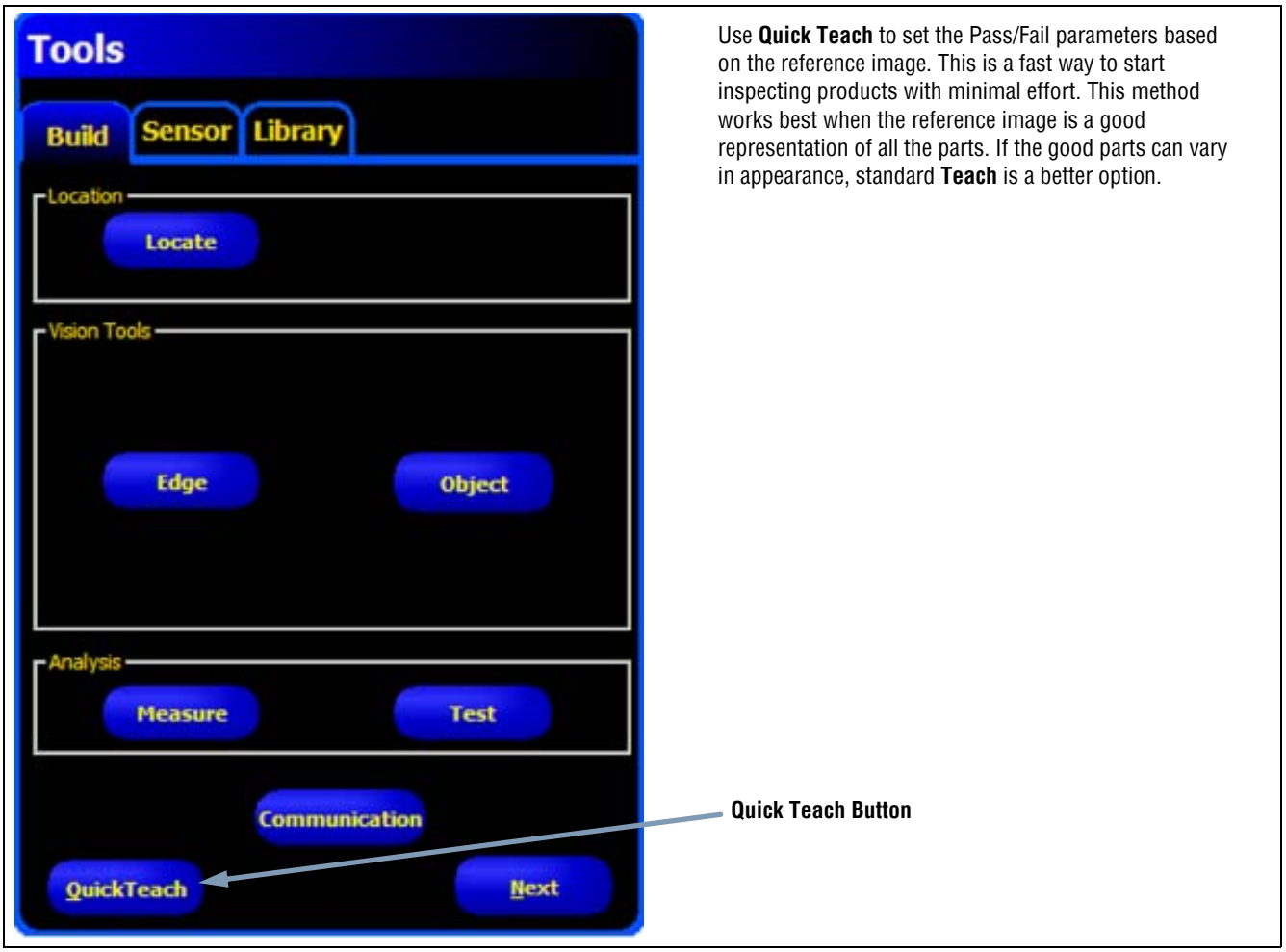
Teach Overview . . . . . 114
Quick Teach . . . . . 114
Teach . . . . . 115
Teach Screen . . . . . 116
Teaching an Inspection . . . . . 117
Reviewing Results . . . . . 119

# Teach Overview

The inspection parameters can be taught automatically by using the Teach function. There are two Teach options: **Quick Teach** and **Teach**.

## Quick Teach

The **Quick Teach** button is in the Tools window, as shown below.


Tools
Build
Sensor
Library
Location
Locate
Vision Tools
Edge
Object
Analysis
Measure
Test
Communication
QuickTeach
Next
Quick Teach Button
Use **Quick Teach** to set the Pass/Fail parameters based on the reference image. This is a fast way to start inspecting products with minimal effort. This method works best when the reference image is a good representation of all the parts. If the good parts can vary in appearance, standard **Teach** is a better option.

***Quick Teach Button on the Tools Build Tab***

Selecting **Quick Teach** triggers the following events:

1. The results calculated from the reference image are transferred to the minimum and maximum fields in the Test tool.
2. If the **Results** field includes a tolerance (like the shortest distance), then the additional tolerance is calculated (default is 10%).
3. The Save window appears and prompts the user to save the inspection on the Sensor.
4. The software proceeds to the Run screen.

| ⚠ CAUTION | **Quick Teach will overwrite all** the minimum and maximum values in the Test tool. If values were entered manually, or no changes are desired, go directly to Run without selecting **Quick Teach**. |
|---|---|

## Teach

Click **Teach** in the Main Menu toolbar to automatically set the Pass/Fail parameters based on a sample of good parts. Instead of using the reference image as the good part, Teach uses new good parts that are presented to the Sensor under running conditions.

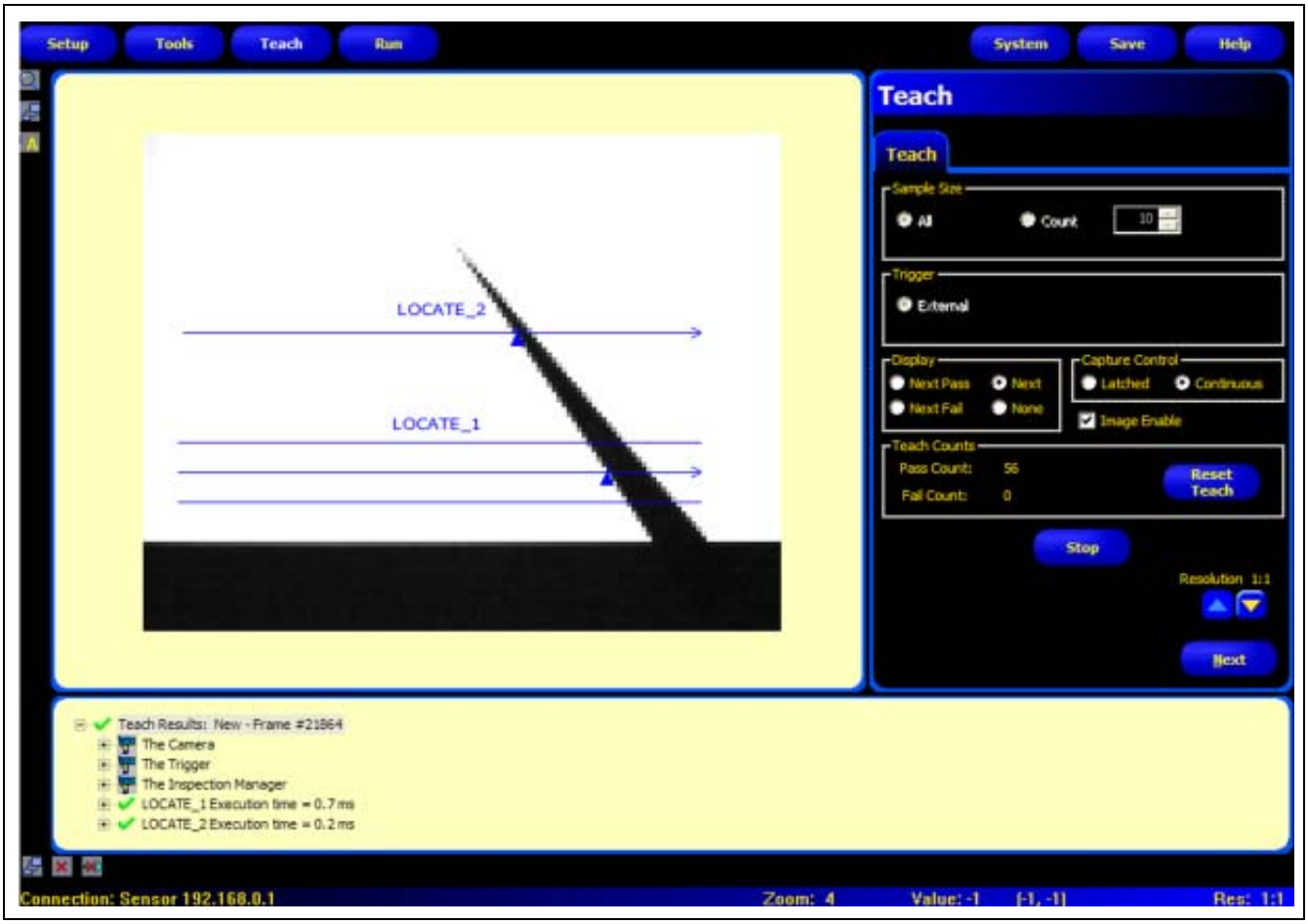
NOTE: The Teach screen looks very similar to the Run screen. Verify that the Sensor is at the Run screen and not the Teach screen before running an inspection.

There is no limit to the sample size during the Teach process. Teach will only expand the parameter window. If the current tolerances were greater than the sample set shown during the Teach process, then the Sensor will retain the old tolerances. Use **Teach** when there is a large part variation between the good parts.

| ⚠ CAUTION | **Only use good parts with Teach**. A taught bad part will pass the inspection. |
|---|---|

# Teach Screen

Use the Teach screen to automatically set judgment tolerances to accommodate all variations of good product.




***Teach Screen***

After teaching the inspection, typically proceed to the Run screen to run it.

NOTE: Before entering the Run screen, a pop-up prompts the user to save the inspection. Save the inspection to one of the memory locations on the Sensor.

As an alternative to teaching, enter judgment tolerances in the **Results** tab in the Test tool, and run the inspection without teaching. See Test Tool Configuration (in Section 7, Tools) on page 92.

### To display the Teach screen:

Click the **Teach** button on the Main Menu toolbar, or click the **Next** button on the Tools screen **Build** tab.

### To exit Teach options:

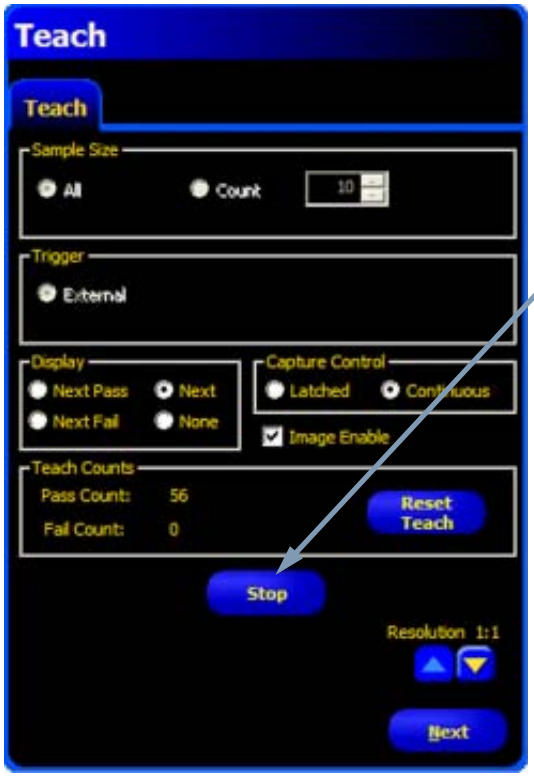
To go to the Run screen, click the **Next** button on the **Teach Tool** tab. To go to another destination, click one of the options in the Main Menu toolbar.

NOTE: Teach will only widen the minimum and maximum values in the test tools. If some or all values in the test tool(s) are entered manually, then Teach will only widen these tolerances, if needed, for the taught inspection.

# Teaching an Inspection

Teaching on a number of known good samples finds acceptable variations and automatically sets the judgment tolerances to accommodate the full range of acceptable results.

Several Teach parameters may be selected in the **Teach Tool** tab, such as how many images to consider during a teaching session and what type of captured images to display.




### To teach an inspection:

Set preferences from the various Teach options, and click the **Start** button.

The **Start** button turns into a button after it is clicked.


Options are explained in the following table.

### To stop teaching an inspection:

Click the **Stop** button.

***Teach Tool Tab***

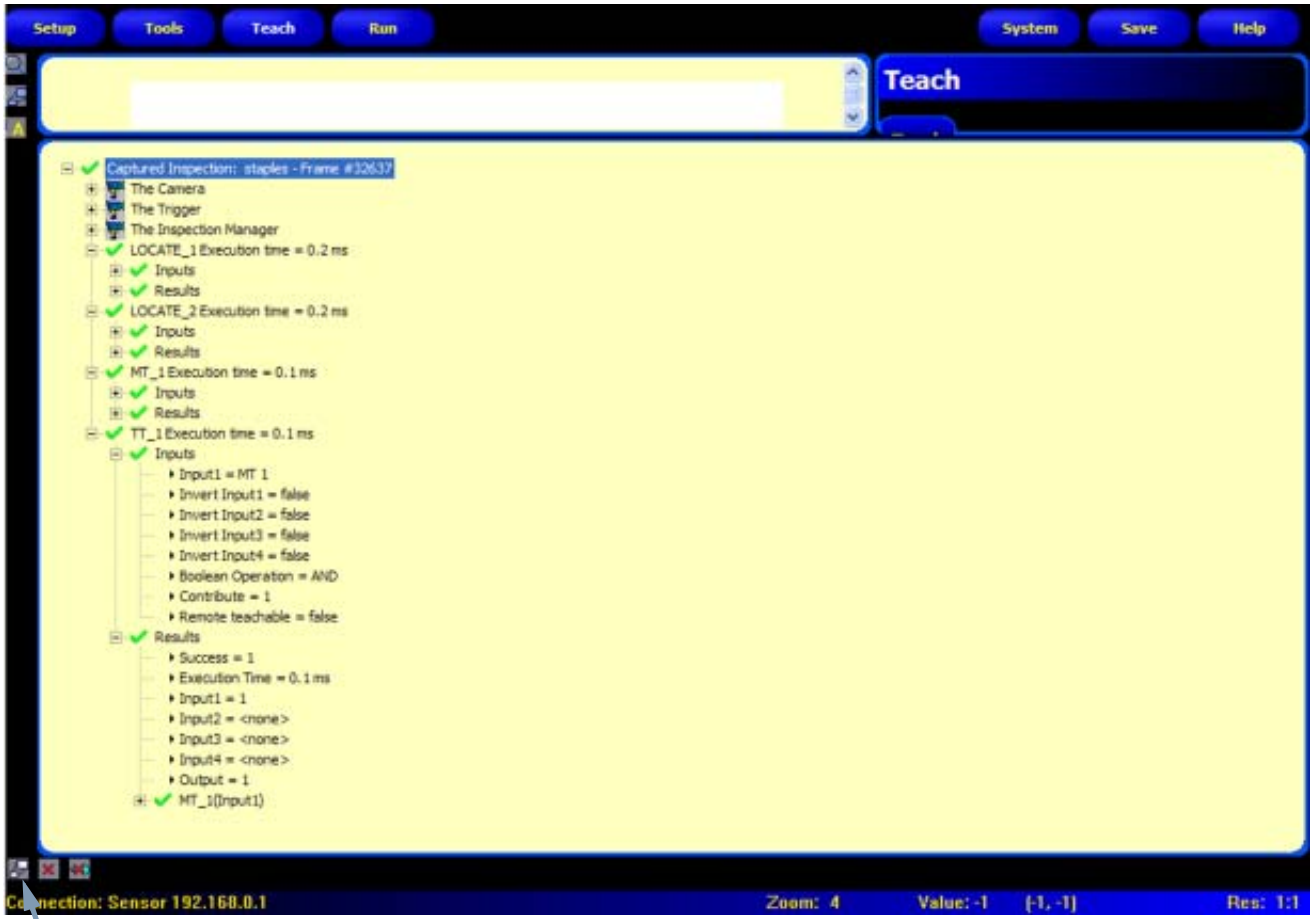
| | |
|---|---|
| | **Sample Size (default: All)**<br>- Use **All** to not limit the Teach sample size.<br>- Use **Count** to have the Sensor automatically stop the Teach process after a set number of samples.<br>Use the Count option when there is a known sample set size. Use the arrows to increase or decrease the sample size. When the sample size is reached, the Sensor will stop the Teach process, and the **Start/Stop** button will return to displaying **Start**. |
| | **Trigger (default: External)**<br>The Sensor must receive an external trigger (Pin 3) to accept a sample. |

| | |
|---|---|
| | **Display (default: Next)**<br>Determines when information is updated on the PC<br>- **Next Pass:** Display the next passing inspection.<br>- **Next Fail:** Display the next failed inspection.<br>- **Next:** Display the next available inspection.<br>- **None:** Do not display inspections. |
| | **Capture Control (default: Continuous)**<br>Determines how often information is updated on the PC<br>- **Latched:** Sets the Display option to **None** after an inspection is displayed to prevent displaying additional inspections.<br>- **Continuous:** Continuously updates the inspection information according to the display option.<br>NOTE: The display may not capture every inspection. |
| | **Image Enable (default: Unchecked)**<br>Determines if the image is included in the result information<br>- **Checked:** The inspection image and results will update upon capture.<br>- **Unchecked:** Only the results will update upon capture.<br>NOTE: Displaying the image on the PC will add to the inspection time. |
| | **Teach Counts**<br>Tracks the number of samples used in each Teach process. Teach ignores samples that fail. Samples fail for the following reasons:<br>- An Edge tool before the Test tool fails.<br>- A Locate tool before the Test tool fails.<br>- Measure tool fails to find two points.<br>- Time-out error.<br>- An ROI rotates or translates off the screen.<br>Click the **Reset Teach** button to clear all previously gathered data. |
| | **Start**<br>Clicking the **Start** button will start the Teach routine. |
| | **Stop**<br>Clicking the **Stop** button will stop the Teach routine. |
| | **Resolution**<br>Increases or decreases the resolution on the displayed image. A lower resolution will have a faster PC update. The resolution does not change the inspection. Resolution options are 1:1, 4:1, 16:1, and 64:1. |
| | **Next**<br>Clicking the **Next** button will prompt the user to save the inspection, and the application will proceed to the Run screen. |

# Reviewing Results

Results of the inspection are displayed in the Results window, shown below. In this window, access such statistics as tool execution status and time, Test tool results, and any errors.

Enlarge the window to the size shown below by clicking on the **Expand** button.




***Results Window***

To learn more about the Results window, see Results Window (in Section 11, Run) on page 129.

# 10. Remote Teach

This section explains teaching inspections on good product using the Remote Teach line.

Overview . . . . . 121
Timing Sequence . . . . . 123
Results . . . . . 124

## Overview

The Remote Teach function is a method of remotely updating inspection parameters in Run mode. Vision tool(s) and Test tool(s) can each be selected to be taught or not taught. To remotely teach an inspection, the Remote Teach function must be enabled on each tool to be taught.

NOTE: The Location tools, the Measure tool, and the Communication tool are **not** affected by Remote Teach.

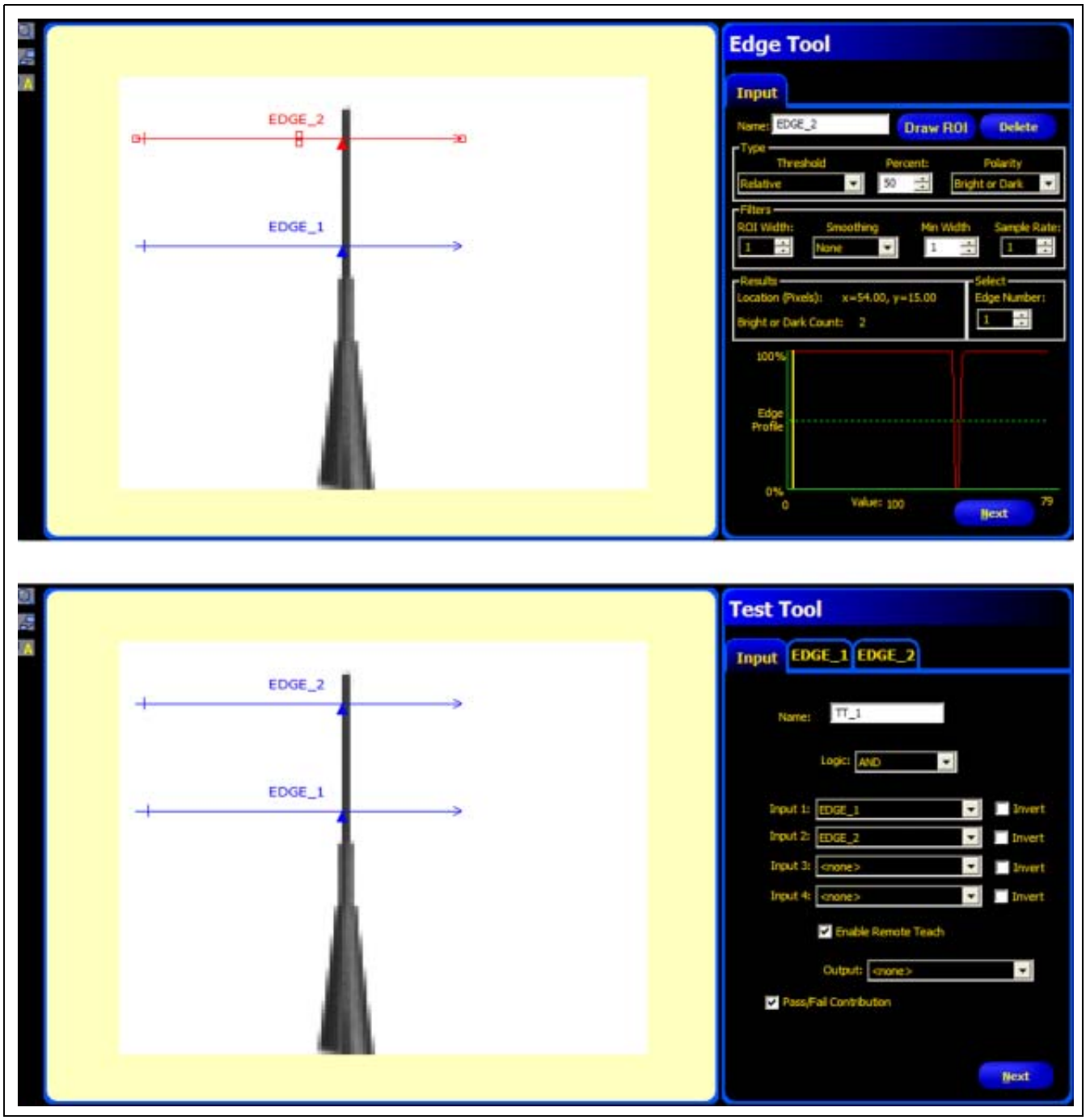
Understanding the sequence of events in the Sensor during a Remote Teach will help the user implement successful Remote Teach applications. The sequence of events is as follows:

1. With the Sensor in Run mode (and Ready), the user pulses the Remote Teach line (Pin 2, gray wire).
2. The Sensor recognizes that the Remote Teach line is active and waits for the next valid trigger.
3. At the next valid trigger, Ready goes inactive (the Green Ready LED shuts OFF), and the Sensor acquires a new image.
4. The Sensor adjusts both the Search ROI and the Pattern ROI for the Vision tool (if the inspection uses Location tools).
5. The Vision tool learns the new pattern and performs the Count analysis.
6. The Sensor adjusts the minimums and maximums in the Test tool (if the Test tool is enabled for Remote Teach).
7. The inspection will indicate **Pass** if the pattern meets the requirements of the Vision tool and (if the Test tool is enabled for Remote Teach) if the evaluation of the Test tool(s) passes with the adjusted minimums and maximums.
8. The inspection will **Fail** if the Vision tool(s) or the Test tool(s) fails. If the inspection fails, another Remote Teach sequence or user intervention is required.

## Remotely Teaching a Tool

To remotely teach a tool, **the user must enable Remote Teach on each tool to be taught**. This can be accomplished by clicking on the "Enable Remote Teach" box in the tool window before the inspection is put into Run mode (typically performed when inspection is created).

Vision tools and the Test tool are shown below:




***Vision Tool and Test Tool Examples***

To perform a Remote Teach, do the following:

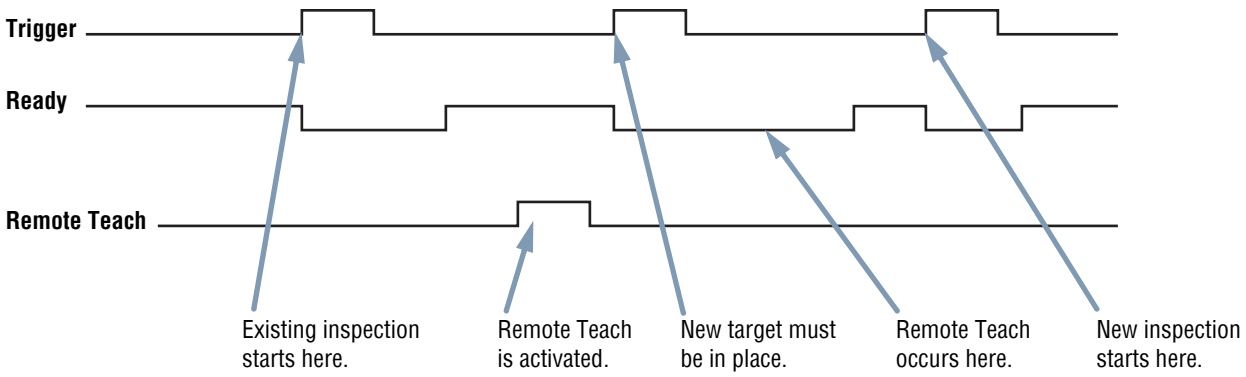
1. Ensure that the correct tools are enabled for Remote Teach.
2. Ensure that the Sensor is in Run mode.
3. Ensure that the Sensor is indicating Ready (Green Ready LED is ON).
4. Activate the Remote Teach input.
5. Position the target as desired.
6. Trigger the Sensor.

If the steps above are followed a Remote Teach will occur, and subsequent inspections will be performed with the newly-learned parameters of the Vision tool(s) and the Test tool.

| | |
|---|---|
| **⚠ CAUTION** | A successful Remote Teach will occur ONLY if the new target is similar in contrast to the original target. **The exposure time and gain are NOT modified during Remote Teach.** |

# Timing Sequence

The timing for the Remote Teach sequence is shown in the following diagram (assumes Remote Teach is enabled on the tools and that all signals meet minimum times):




NOTES:

- Notice how the Remote Teach time is longer than the normal inspection time. This time is inspection-dependent (tool-dependent), but the user can safely assume two times the normal inspection time in most cases.
- It is also important to note that the remotely-taught parameters are **not** saved to non-volatile memory; hence, the remotely-taught inspection is good only as long as Run mode is maintained and power to the Sensor is not lost.
- To record the remotely-taught inspection, the logging function must be used. See Run Log Tab (in Section 11, Run) on page 133.

***Remote Teach Timing Sequence***

# Results

Remote Teach will indicate normal Pass/Fail results. To clarify normal results, the rules are as follows:

- If Location tools were used in the inspection, then they must perform correctly; that is, the Locate tool must find an edge, and the Location tool(s) must find a pattern. If they do not perform correctly, the Remote Teach will fail, and the inspection will indicate **Fail**.

  NOTE: If the Remote Teach fails for this reason, then the new pattern will not be taught, and the existing inspection will still be valid.

- If Location tools were used and they performed correctly or if Location tools were not used, then the Remote Teach will attempt to update the Vision tool (if enabled). If the Vision tool fails, then the Remote Teach will fail, and the inspection will indicate **Fail**.

  NOTE: If the Remote Teach fails for this reason, then the existing inspection is not valid. The Remote Teach inspection will continue to fail until a new inspection is taught or selected (via Product Change) or until the Sensor is taken out of Run mode.

- If the Remote Teach is successful, the inspection will indicate **Pass**, and the new inspection will perform with the new parameters.

# 11. Run

This section explains how to monitor and select inspections.

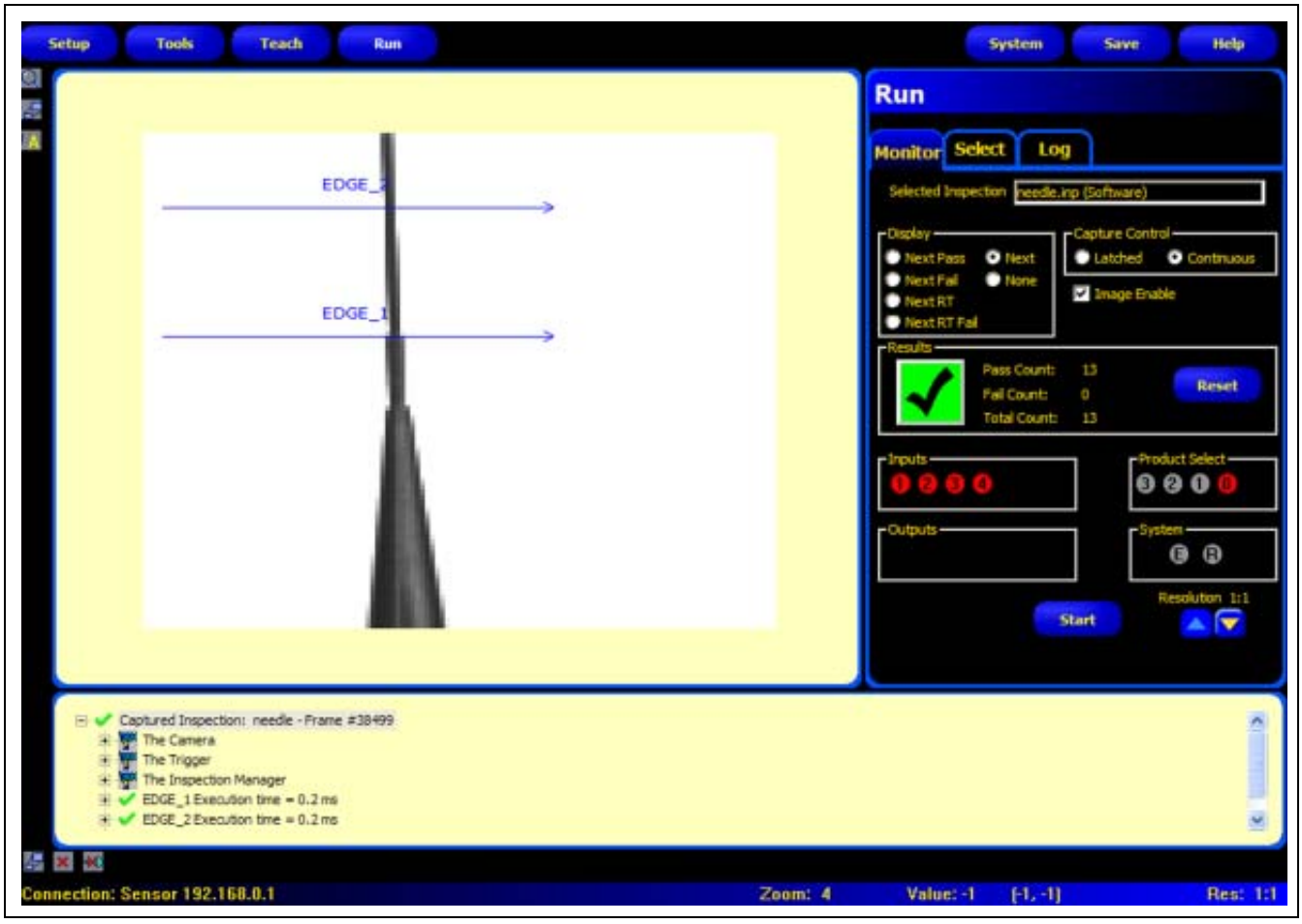
Run Screen . . . . . 126
Run Monitor Tab . . . . . 127
Results Window . . . . . 129
Run Results . . . . . 130
Run Select Tab . . . . . 131
Run Log Tab . . . . . 133

# Run Screen

Use the Run screen to start, stop, monitor, and log an inspection.

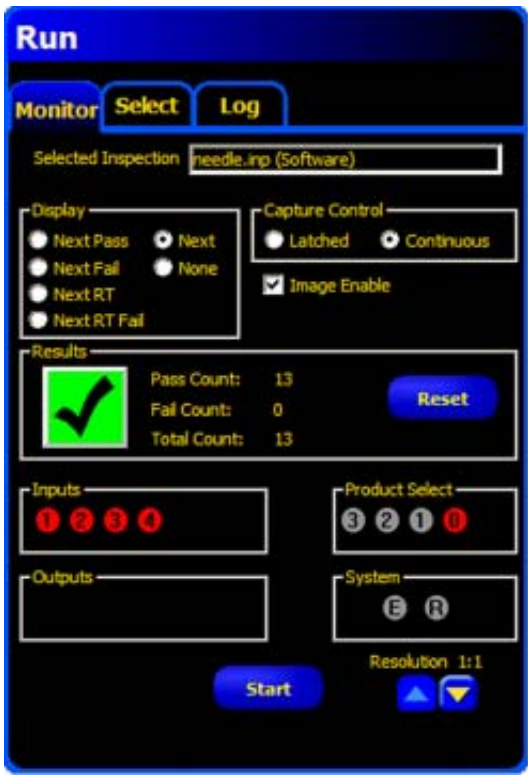
To display the **Monitor** tab on the Run screen (shown below), click **Run** in the Main Menu toolbar. The **Monitor** tab is the default tab in the window.

To exit the Run screen, verify that Run is stopped and click another destination on the Main Menu toolbar.




***Run Screen***

# Run Monitor Tab




While running an inspection, the following can be viewed:

- Pass and Fail counts
- The status of inputs, outputs, Product Select System errors, and whether Sensor is Ready
- Next Pass, Next Fail, Next Remote Teach, Next Remote Teach Fail, Next, None

***Run Screen Monitor Tab***

To run an inspection, set Options and preferences, and click the **Start** button. Options are explained in the following table:

| | |
|---|---|
| | **Inspection Name (default: Last Saved Inspection)**<br>Displays the filename of the selected inspection. |
| | **Display (default: Next)**<br>**Next Pass:** Display next passed inspection.<br>**Next Fail:** Display next failed inspection.<br>**Next RT:** Display next remotely-taught inspection.<br>**Next RT Fail:** Display next failed, remotely-taught inspection.<br>**Next:** Display all inspections. The display is updated continuously, but because of transfer speed limits, not every image will be displayed. For faster image speed, reduce resolution.<br>**None:** Display not updated. |
| | **Capture Control (default: Continuous)**<br>**Latched:** The condition set in **Display** (see above) is displayed or latched until set.<br>**Continuous:** The condition set in **Display** (see above) is displayed. |

**Image Enable (default: checked)**

**Checked:** The PC displays an image of the inspection.

**Unchecked:** The PC will collect the inspection information without an image.

NOTE: Capturing images impacts the Sensor response speed. For high-speed applications where the PC remains connected to the Sensor, **Image Enable** should be unchecked unless absolutely required.

**Results**

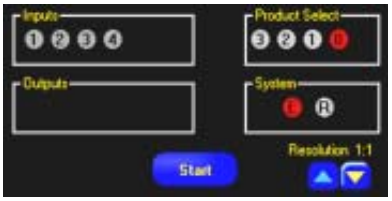
**Pass Count:** Number of inspections that passed

**Fail Count:** Number of inspections that failed

**Total Count:** Total number of inspections

**Reset:** Click **Reset** to clear the counts for the selected inspection.

NOTE: Each of the 12 stored inspections has its own Pass/Fail registers to store the Pass/Fail counts for that particular inspection.




**Gray** = Inactive (not currently available)
**Red** = Active (not currently available)
**Not Visible** = Not selected as input/output

**Inputs**

Each numbered circle represents an input and its current state.

**Outputs**

Each numbered circle represents an output line and its current state.

**Product Select**

Displays the last latched Product Select (binary encoded).

**System**

**E** = System error
**R** = Ready

NOTE: The results of the discrete I/O are not displayed in real time. They update at an approximate rate of 4 times per second.

**Start/Stop**

The **Start** button turns into a

button after it is clicked.

Click **Start** to run the inspection.

Click **Stop** to stop running the inspection.

**Resolution**

Max. = 1:1
Min. = 64:1

Click on the **Up** arrow to increase the image resolution.

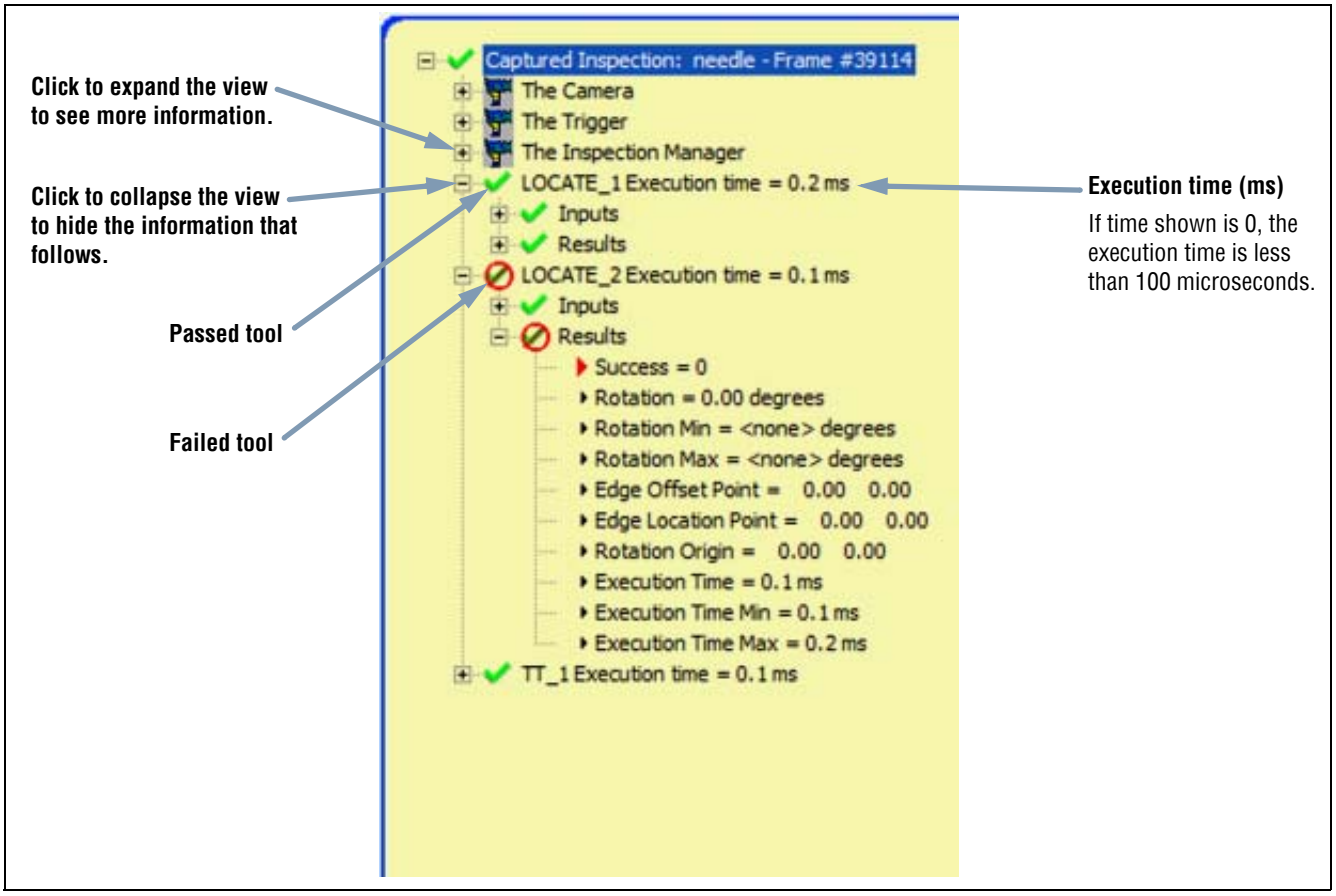
Click on the **Down** arrow to decrease the image resolution.

NOTE: Changing the resolution affects the display only; it does not affect the accuracy of the inspection.

# Results Window

In the Run screen, the Results/Navigation window at the bottom of the display defaults to the Results window shown below. The Results window provides the following information:

**Capture:** All available information about the last displayed inspection


Click to expand the view to see more information.
Click to collapse the view to hide the information that follows.
Passed tool
Failed tool
Captured Inspection: needle - Frame #39114
The Camera
The Trigger
The Inspection Manager
LOCATE_1 Execution time = 0.2 ms
Inputs
Results
LOCATE_2 Execution time = 0.1 ms
Inputs
Results
Success = 0
Rotation = 0.00 degrees
Rotation Min = <none> degrees
Rotation Max = <none> degrees
Edge Offset Point = 0.00 0.00
Edge Location Point = 0.00 0.00
Rotation Origin = 0.00 0.00
Execution Time = 0.1 ms
Execution Time Min = 0.1 ms
Execution Time Max = 0.2 ms
TT_1 Execution time = 0.1 ms
Execution time (ms)
If time shown is 0, the execution time is less than 100 microseconds.

***Results Window***

Each tool in the list can be expanded to show its results. Each result shown indicates the tolerance assigned to the parameter and its current value.

- If the current value falls within the Test tool's set tolerance or if the tool executed properly, then a green ✓ symbol is shown beside that parameter (see **Passed tool** in the illustration above).
- If the current value falls outside the Test tool's set tolerance or if the tool failed to execute properly, then a red ⊘ symbol is shown beside that parameter (see **Failed tool** in the illustration above).

# Run Results

| Name | Level | Parent Level | Description |
|---|---|---|---|
| Current Inspection | First | None | Name of current running inspection. |
| The Camera | Second | Inspection Name | **Sensor Information:**<br>- Gain; see Setting Exposure and Gain (in Section 5, Setup) on page 40.<br>- Exposure time (ms). |
| The Trigger | Second | Inspection Name | **Trigger Input Information (see the following referenced subsections in Section 5, Setup):**<br>- **Divide:** See Trigger Divide (range: 1 – 10,000 triggers) on page 46.<br>- **Delay:** See Trigger Delay (range: 0 – 8,000 ms) on page 46.<br>- **Width:** See Minimum Trigger Width (range: 1 – 8,000 ms) on page 46.<br>- **Polarity:** See Polarity on page 44. |
| The Inspection Manager | Second | Inspection Name | **General inspection information:**<br>- **Fail hold time (ms):** how long a failed image is displayed on the monitor<br>- **Power-up time:** time since last shutdown (resolution = second)<br>- **Pass count**<br>- **Fail count**<br>- **Missed trigger count:** total number of triggers missed because Sensor was not Ready<br>- **Lifetime:** how long the Sensor has been turned on (resolution = 1 hour)<br>- **Total inspection time minimum (ms):** minimum inspection time recorded (resolution = 0.1 ms)<br>- **Total inspection time maximum (ms):** maximum inspection time recorded (resolution = 0.1 ms)<br>- **Total inspection time (ms)*:** inspection time from trigger until end of processing time for last inspection (resolution = 0.1 ms) (does not include inspection capture to PC*)<br>- **Config timestamp:** when inspection was created<br>* Capturing an image on the PC adds to the inspection time. Set display settings to **None** to decrease the inspection time to a minimum. |
| Tools (tool name) | Second | Inspection Name | **Information about current tool:**<br>- **Execution time** (resolution = 0.1 ms)<br>- **Inputs** (parameters set for the current tool)<br>- **Results** (results of the current tool) |
| System Log | First | None | Not used |

# Run Select Tab

The **Select** tab on the Run screen enables the user to specify Product Select lines and Image Hold and Trigger Delay times. Option descriptions follow.

***Run Screen Select Tab***

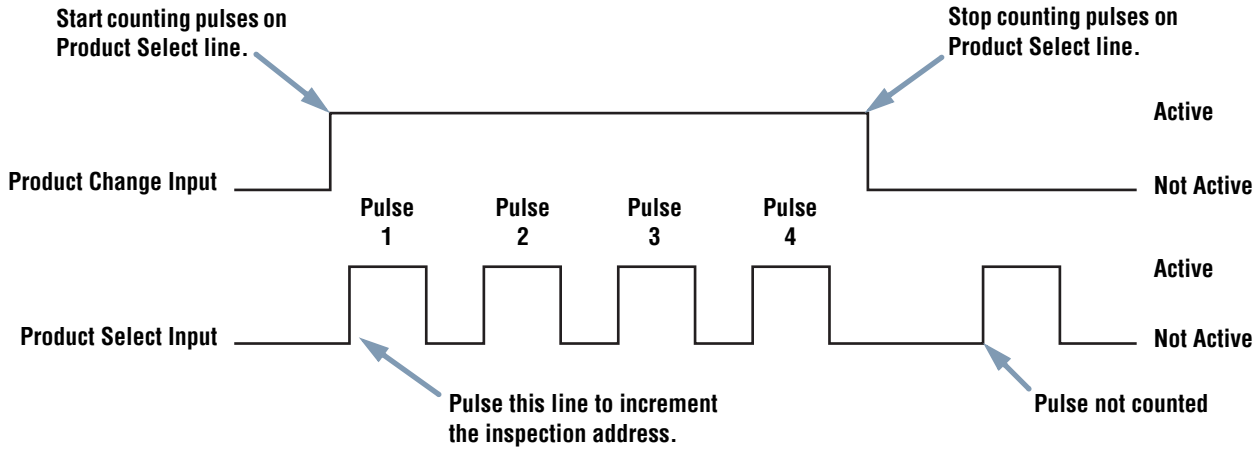
**Product Select Line**

- The **Hardware Input** option signals the Sensor to run the option currently selected by the Product Change and Product Select line. This option allows the Product Change and Product Select input to change the inspection. When the input to the Product Change pin becomes active, the Sensor samples the Product Select pin and determines which inspection to load from the Sensor memory.
- The **Software Override** option signals the Sensor that the inspection to run will be manually selected. With this option selected, the inspection displayed next to the **Override** button is the inspection that runs.

The Product Change and Product Select Timing Diagram on the next page shows the pin combinations and the resulting inspections.

**TIP**

The Product Change and Product Select line is used to swap between inspections. Select any of the (up to 12) stored inspections to be the next inspection to run. A time delay, typically less than 1 second, is required to change the inspections.




NOTES:

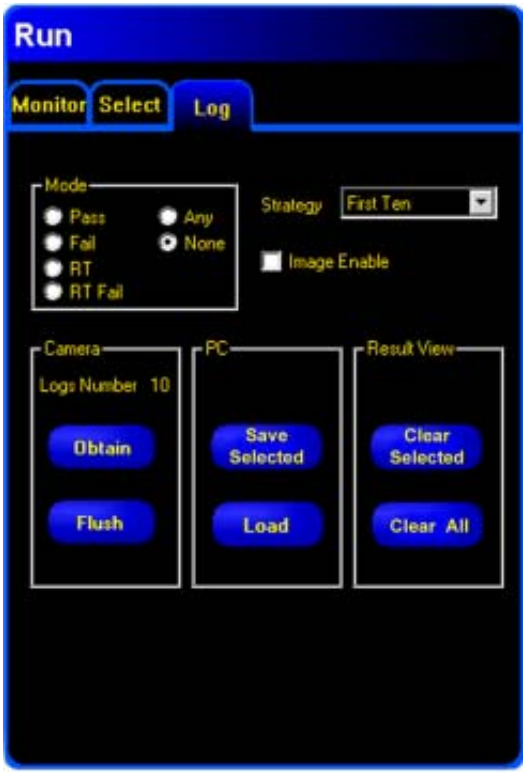
- The minimum pulse width on Product Select is 1 millisecond active and 1 millisecond inactive.
- In this example, the Sensor will stop executing the inspection it is currently running, go to address number four (because there are four pulses), load the inspection at location four, enter Run mode, and execute the inspection on the next valid trigger.
- If the Sensor is in Run mode, the Product Change line should be activated only when the Sensor is Ready (Green Ready LED is ON). If the Product Change line is activated when the Sensor is in Run mode but performing an inspection (not Ready), the current inspection will be aborted, and the Sensor will proceed to load the inspection at the indicated address.
- If the Product Change line is activated when the Sensor is not in Run mode (Setup mode, for example), then the Sensor will go to the address indicated (address number four in this case) and begin executing.
- The maximum number of pulses is limited by the number of inspections possible on the Sensor.

***Product Change and Product Select Timing Diagram***

| | |
|---|---|
| | **Failed Image Hold (default: 1 second)**<br>Enter how many seconds failed images should be displayed on the optional NTSC video monitor. |
| | **Trigger Delay Adjust (default: 0 ms)**<br>Enter how long (in ms) to delay the Sensor before it takes a picture after receiving a valid trigger. |

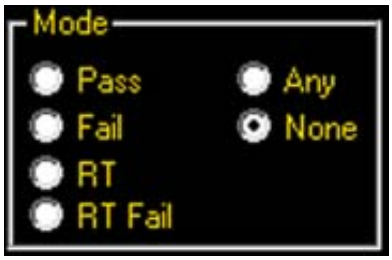
| | |
|---|---|
| **TIP** | Using the Trigger Delay when a part is triggered too early may be easier than moving the Sensor. |

# Run Log Tab




The **Log** tab on the Run screen enables the user to select logging modes, specify how many inspections to log and where, and specify what to do with current results. Option descriptions follow.

***Run Screen Log Tab***




**Mode (default: None)**
**Pass:** Log only passed inspections based on Strategy.
**Fail:** Log only failed inspections based on Strategy.
**RT:** Log remotely-taught inspections based on Strategy.
**RT Fail:** Log failed, remotely-taught inspections based on Strategy.
**Any:** Log all inspections based on Strategy.
**None:** Log not updated.

**Strategy (default: First Ten)**
**First Ten:** Store the first 10 inspections that meet the mode criteria.
**Last Ten:** Store the previous 10 inspections that meet the mode criteria.
**First and Last Five:** Store the first 5 and last 5 inspections that meet the mode criteria.

| | |
|---|---|
| | **Sensor**<br>Shows the number of stored inspections currently in the Sensor's memory.<br>**Obtain:** Moves the stored inspection data from the Sensor's memory to the GUI's memory.<br>**Flush:** Deletes all stored inspections from the Sensor's memory. |
| | **PC**<br>**Saved Selected:** Allows the user to write the current log file from the GUI's memory onto a hard drive or other storage device.<br>**Load:** Allows the user to load a saved file from the computer's hard drive or other storage device into the GUI to be viewed. |
| | **Result View**<br>**Clear Selected:** Deletes the currently selected inspection from the GUI's memory.<br>**Clear All:** Deletes all inspections from the GUI's memory. |

# 12. System Setup

This section explains how to configure the Sensor and diagnose system errors in the System Setup window.


Sensor Select Tab . . . . . 136
PC (GUI) to Sensor Connection Setup . . . . . 137
Ethernet (RJ 45) . . . . . 137
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### To display the System Setup window:

Click the **System** button in the Main Menu toolbar. Use the tabs in the System Setup window, shown on page 136, to configure the Sensor and diagnose system errors.

### To clear changes:

Click **Cancel**.

### To save changes and exit the System Setup window:

Click **OK**.

**To exit the System Setup window without changes:**

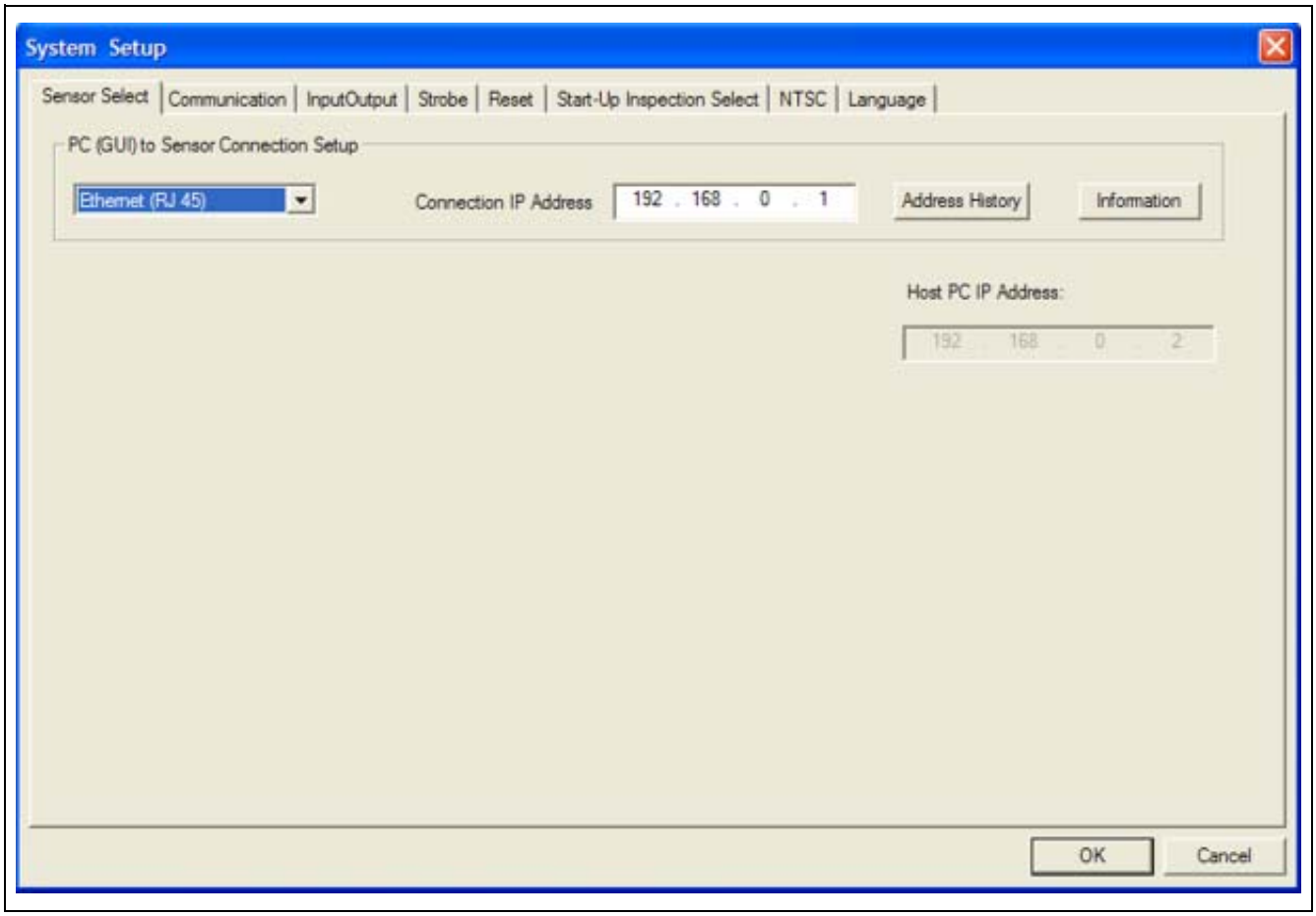
Click .

NOTE: To make changes to the Sensor selections, an inspection must not be running. To stop a running inspection, click the **Stop** button in the **Run** tab. To save changes, click **OK** before exiting the tab or closing the window.

# Sensor Select Tab

Use the **Sensor Select** tab to establish the Sensor connection with the PC.

NOTE: An option box to open the **Sensor Select** tab is automatically displayed if the Sensor either is not connected or is connected but with the wrong location selected.

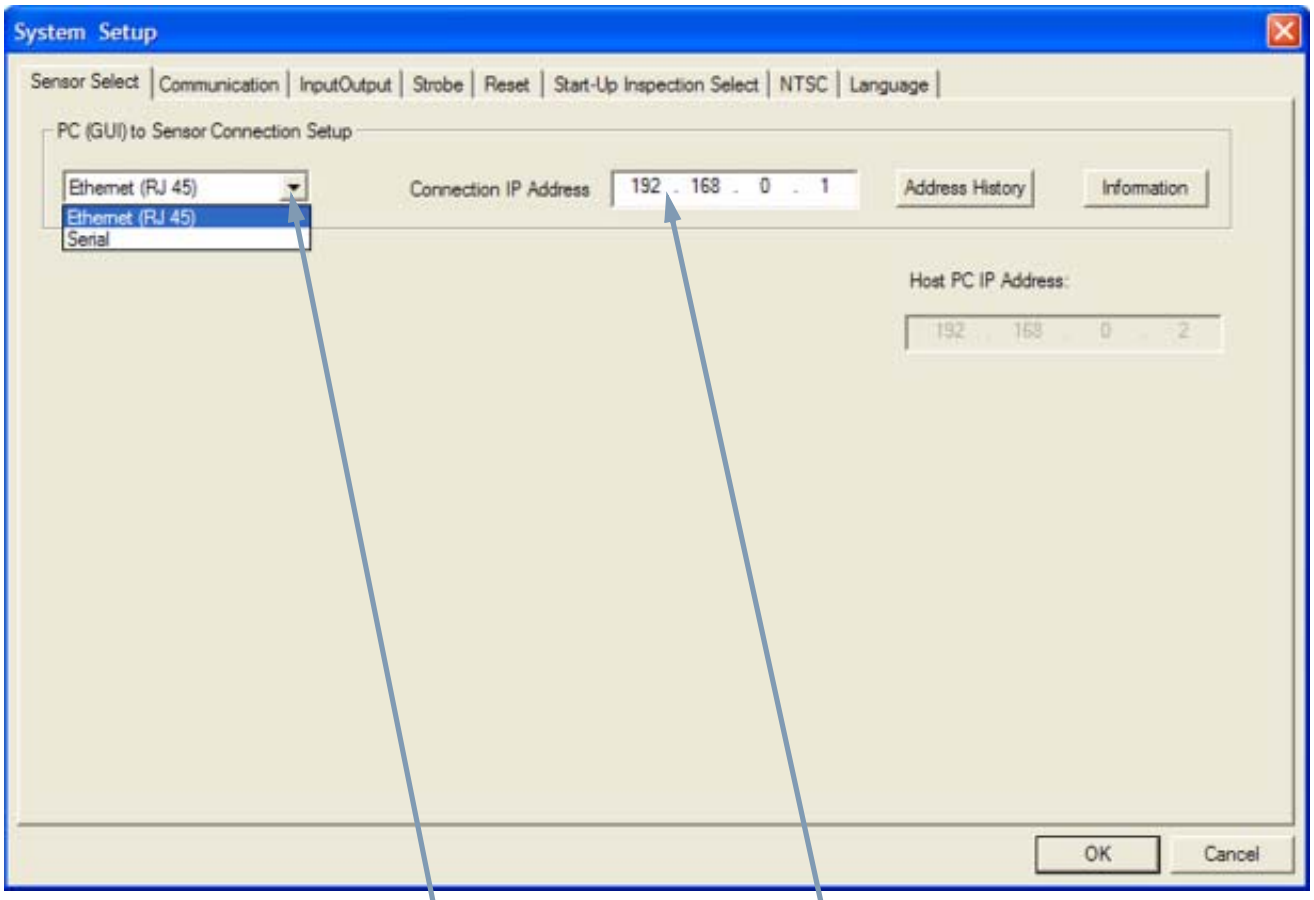



***System Setup Window Sensor Select Tab***

## PC (GUI) to Sensor Connection Setup

Use this field to select whether the Sensor will communicate via the Ethernet port or a serial connection. Choose to use an IP address if the Ethernet port will be used.

## Ethernet (RJ 45)

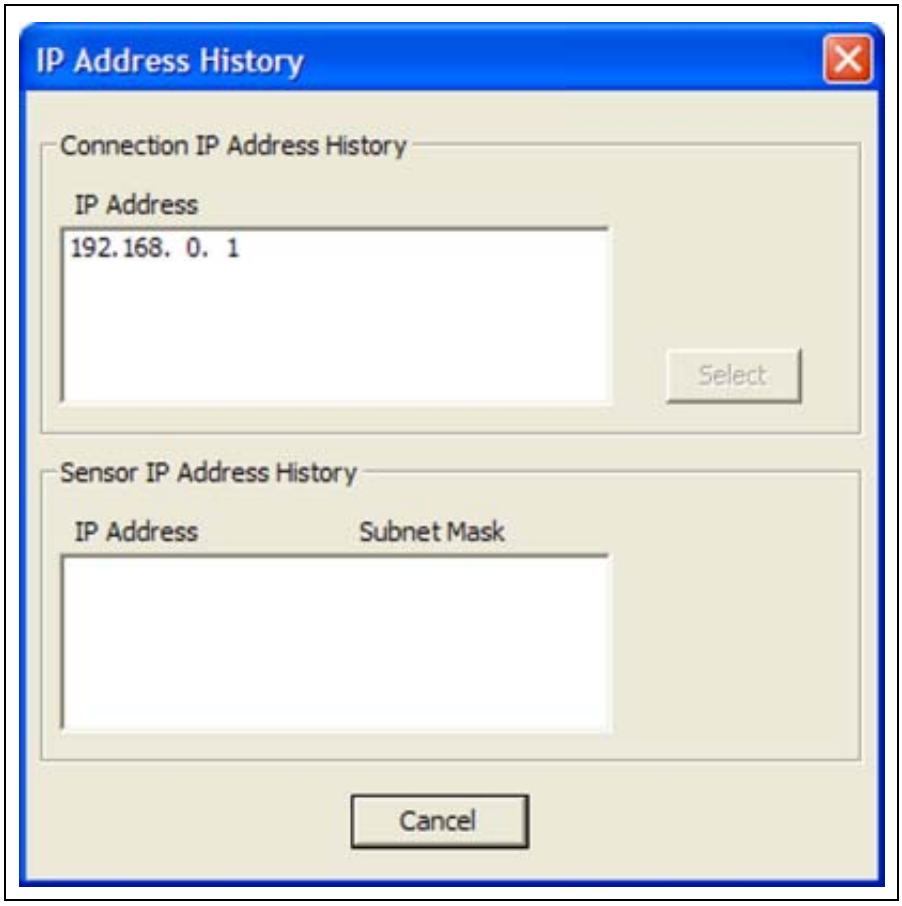



- Shows the IP address the software is looking for.
- Change the IP address to 192.168.0.1 (default IP address of the Sensor).
- Not applicable if **Serial** is chosen.

***PC-to-Sensor Connection Setup Screen***

# IP Address History

Use this button to view previous IP Addresses and Subnet Masks.



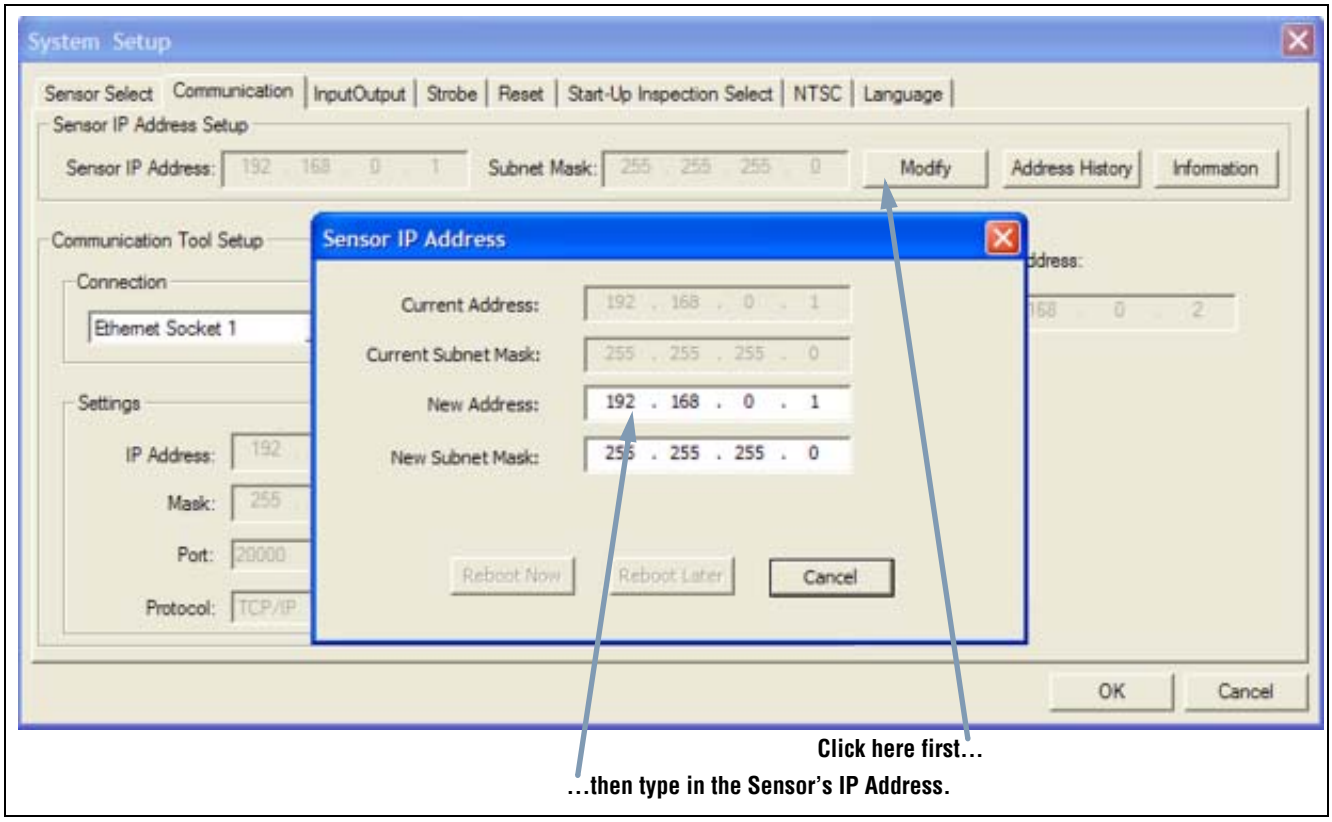

***IP Address History Window***

# Communication Tab

Use the **Communication** tab to modify the IP address and subnet of the Sensor connected to the PC.

NOTE: An option box to open the **Communication** tab is automatically displayed if the Sensor either is not connected or is connected but with the wrong location selected.

## Modify Sensor IP Address




***Communication Tab Sensor IP Address Window***

To change the Sensor IP Address:

1. Enter the new IP address and click **OK**.
2. Change the IP address in the **Communication** tab to the new address.

NOTE: **Performing a system reset in Step 3 may result in lost communication if communicating via an Ethernet connection.**

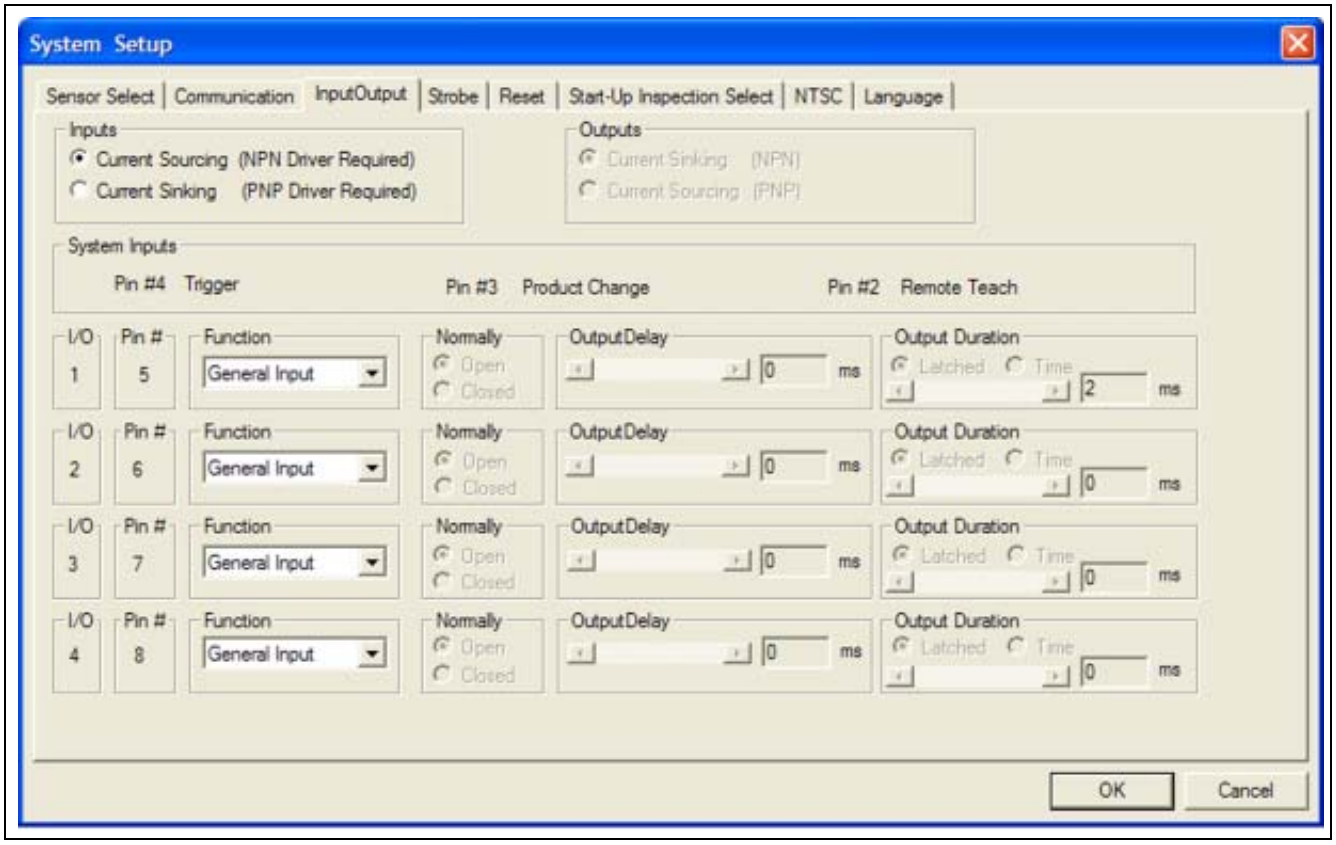
3. Reboot the sensor. Perform a system reset if desired.
4. Restart the software.
5. Change the IP address to the new address in the **Communication** tab.

## Serial Communication

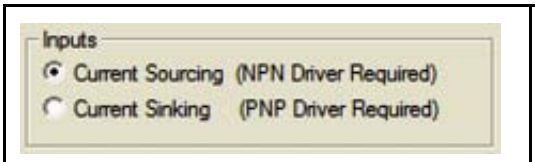
**Serial:** This selection will allow the serial channel to be configured. The Baud Rate, Data Bits, Parity, and Stop Bits may be configured. Currently flow control is NOT selectable.

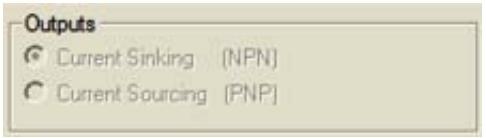
# InputOutput Tab

Use this screen to set the functionality of the 4 programmable I/O connections. Defaults are shown.




***System Setup Window InputOutput Tab***

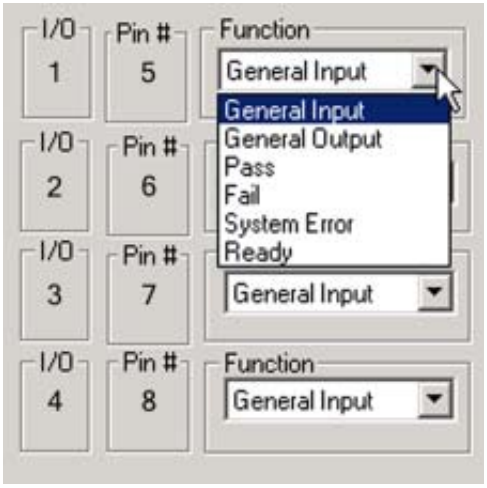



**Inputs (default: Current Sourcing)**

**Outputs (default: Current Sinking)**

Trigger, Product Change, Remote Teach, and Discrete inputs and outputs can be selected as either NPN (current sourcing) or PNP (current sinking). Once NPN or PNP is selected, all inputs/outputs are either NPN or PNP.




**I / O #1, Pin #5**

**I / O #2, Pin #6**

**I / O #3, Pin #7**

**I / O #4, Pin #8**

I/O 1 through 4 in the **I/O** column correspond to Pins 5 through 8 in the **Pin #** column.

**Function (default: General Input)**

**General Input:** Input to the Sensor

**General Output:** Output from the Sensor that can be selected in a Test tool

**Pass:** Active when the entire inspection passes

**Fail:** Active when the inspection fails

**System Error:** Active when a system error occurs

**Ready:** Active when the Sensor is ready to accept another trigger.

**Product Select:** This input is used in conjunction with Product Change to select inspection locations at which to begin execution.

**Normally Open/Closed (default: Open)**

Select the state (open or closed) that the output will take when not active.

**Normally Open:** The output becomes active when the logic condition controlling the output becomes TRUE.

**Normally Closed:** The output becomes inactive when the logic condition controlling the output becomes TRUE.

**Output Delay (default: 0, range: 0–8,000 ms)**

Output Delay is the time from a trigger to start an inspection until the Sensor output turns ON. It is available only for general outputs.

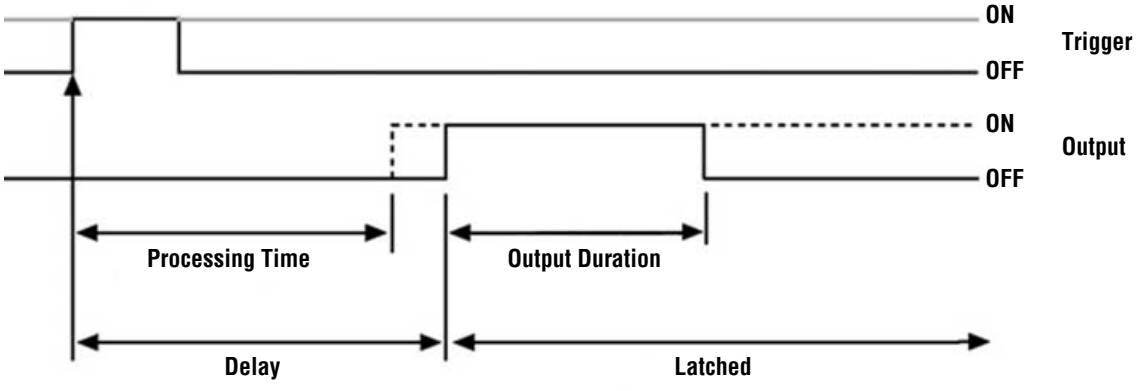
NOTE: If processing time is longer than the output delay, the output will become active immediately after the processing is finished.

**Output Duration (default: Latched, range: 2–8,000 ms)**

**Latched:** Active until the condition changes.

**Time:** Active for a specific length of time.

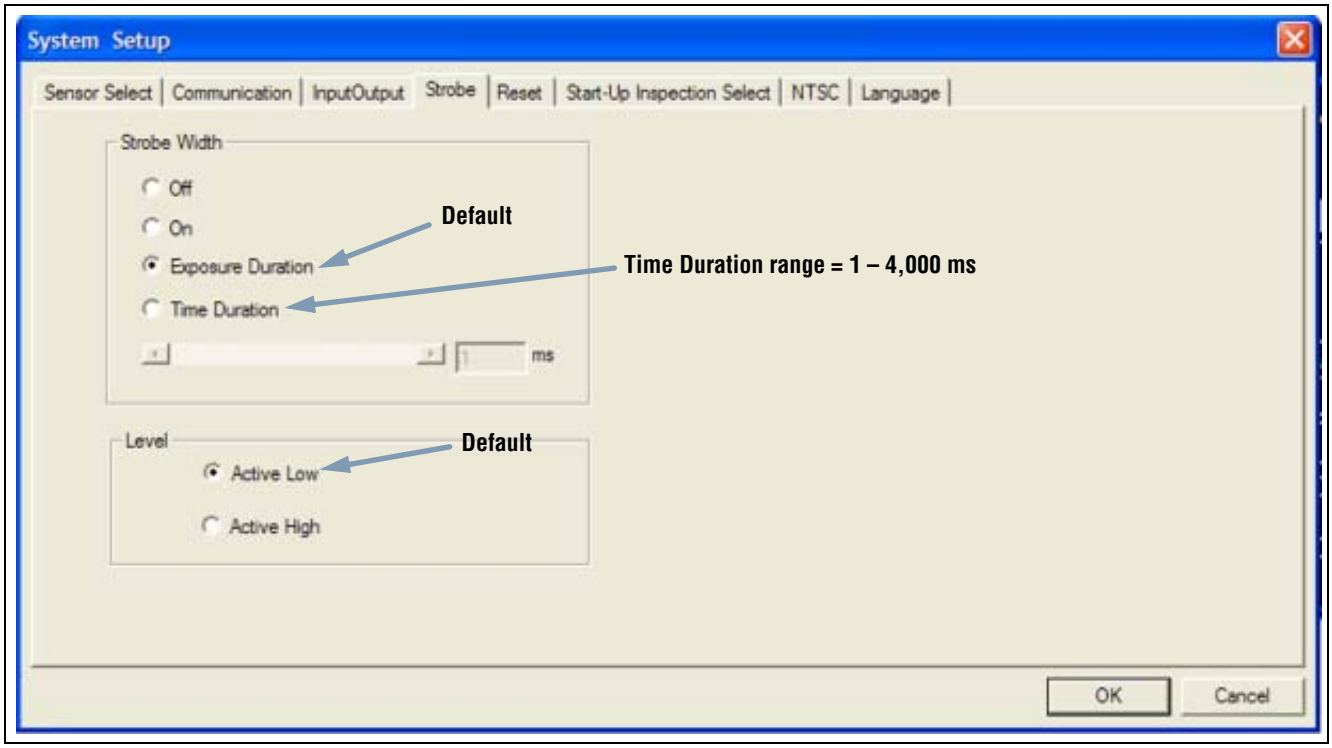
NOTE: This option is available only for the general outputs; the other outputs (Pass, Fail, System Error, and Ready) are latched only.




***Output Delay and Output Duration***

# Strobe Tab

The Strobe option in the System Setup window is shown below. Use the **Strobe** tab to set the strobe signal (Pin 4 on the external light connector) for a strobed light source. The strobe signal is a +5V dc TTL signal.




***System Setup Window Strobe Tab***

## Strobe Width

***Strobe Width Selections in the Strobe Tab of the System Setup Window***

| Selection | Description |
|---|---|
| OFF | The strobe output never becomes active. |
| ON | The strobe output remains active. |
| Exposure Duration | The strobe output is active only while the Sensor is acquiring an image. |
| Time Duration | Sets the duration for active strobe output from the initial valid trigger (minimum pulse width has been satisfied) to the end of the duration. The range is from 0 to 4,000 ms. |

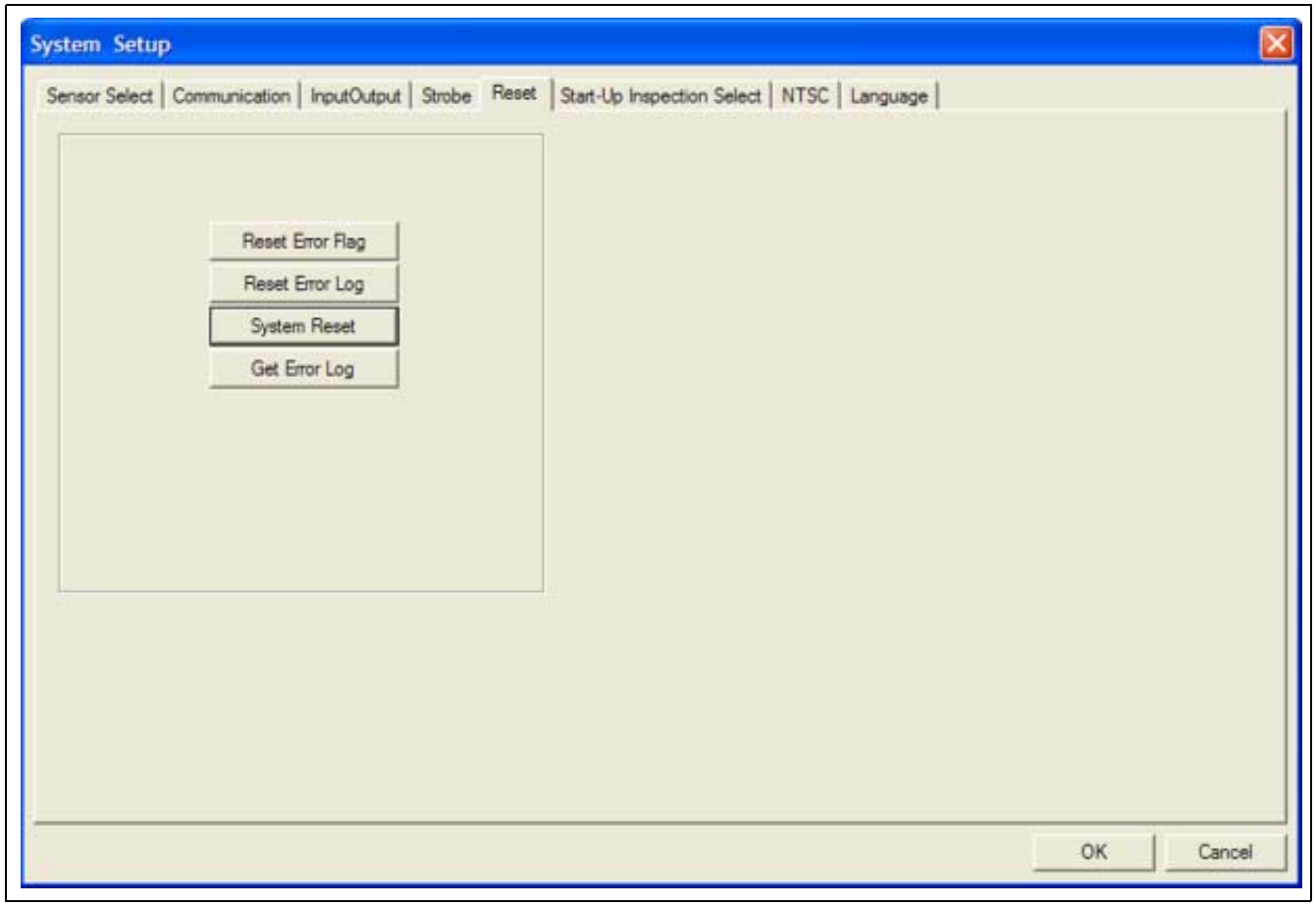
## Level

***Level Selections in the Strobe Tab of the System Setup Window***

| Selection | Description |
|---|---|
| Active High | An active output produces a +5V dc signal. |
| Active Low | An active output produces a 0V dc signal. |

# Reset Tab

Use the **Reset** tab to clear System errors and reestablish Sensor communications.

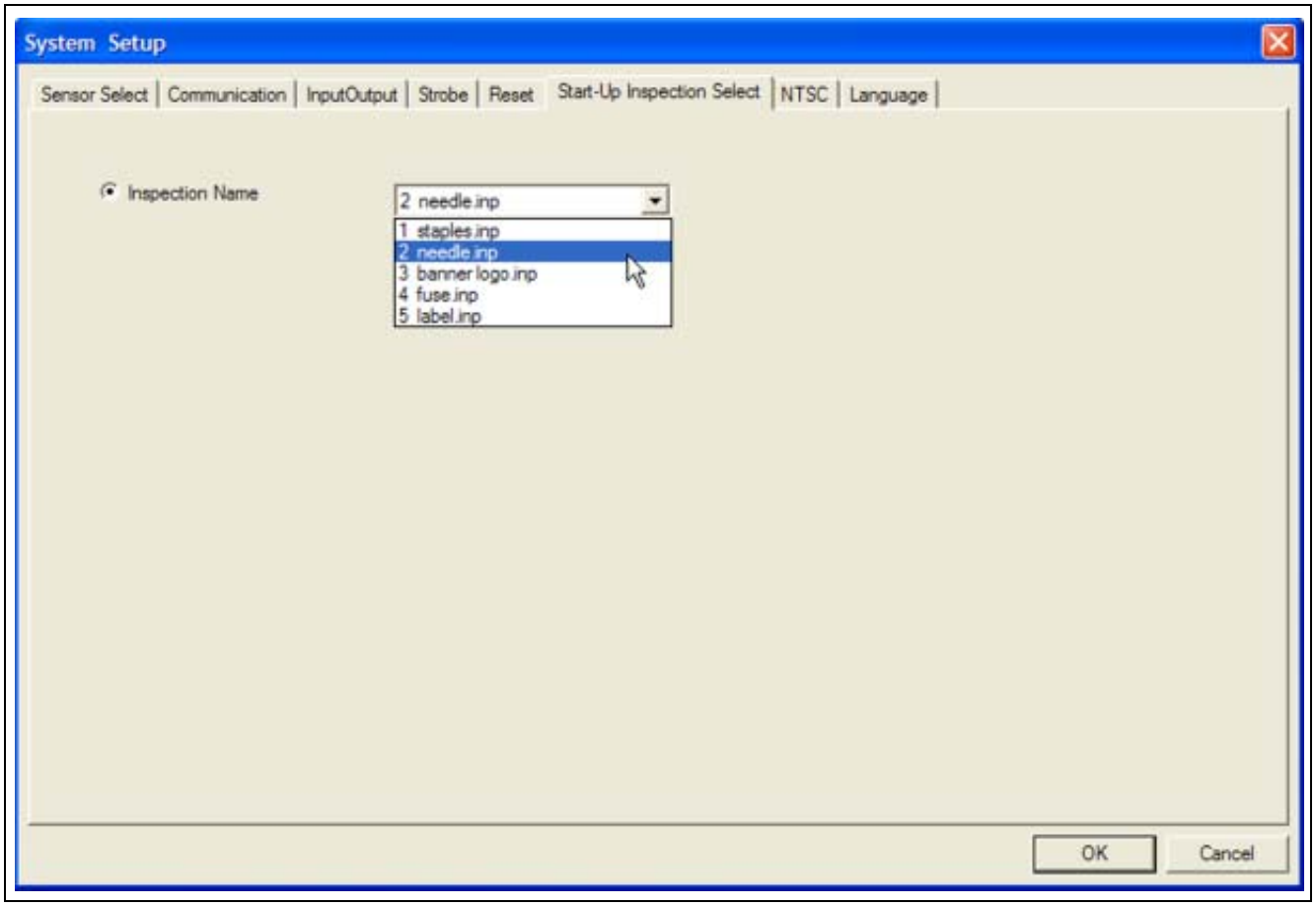



***System Setup Window Reset Tab***

***Selections in the Reset Tab of the System Setup Window***

| Selection | Description |
|---|---|
| Reset Error Flag | Click to clear the Red Error LED on the Sensor. |
| Reset Error Log | Click to clear the error log. |
| System Reset | Click to reboot the Sensor.<br>NOTE: This is a system reboot and will take several seconds. |
| Get Error Log | Click to display the System Log icon in the Navigation/Results window. The System Log records information about all system failures such as communication errors between the PC and the Sensor. |

# Start-Up Inspection Select Tab

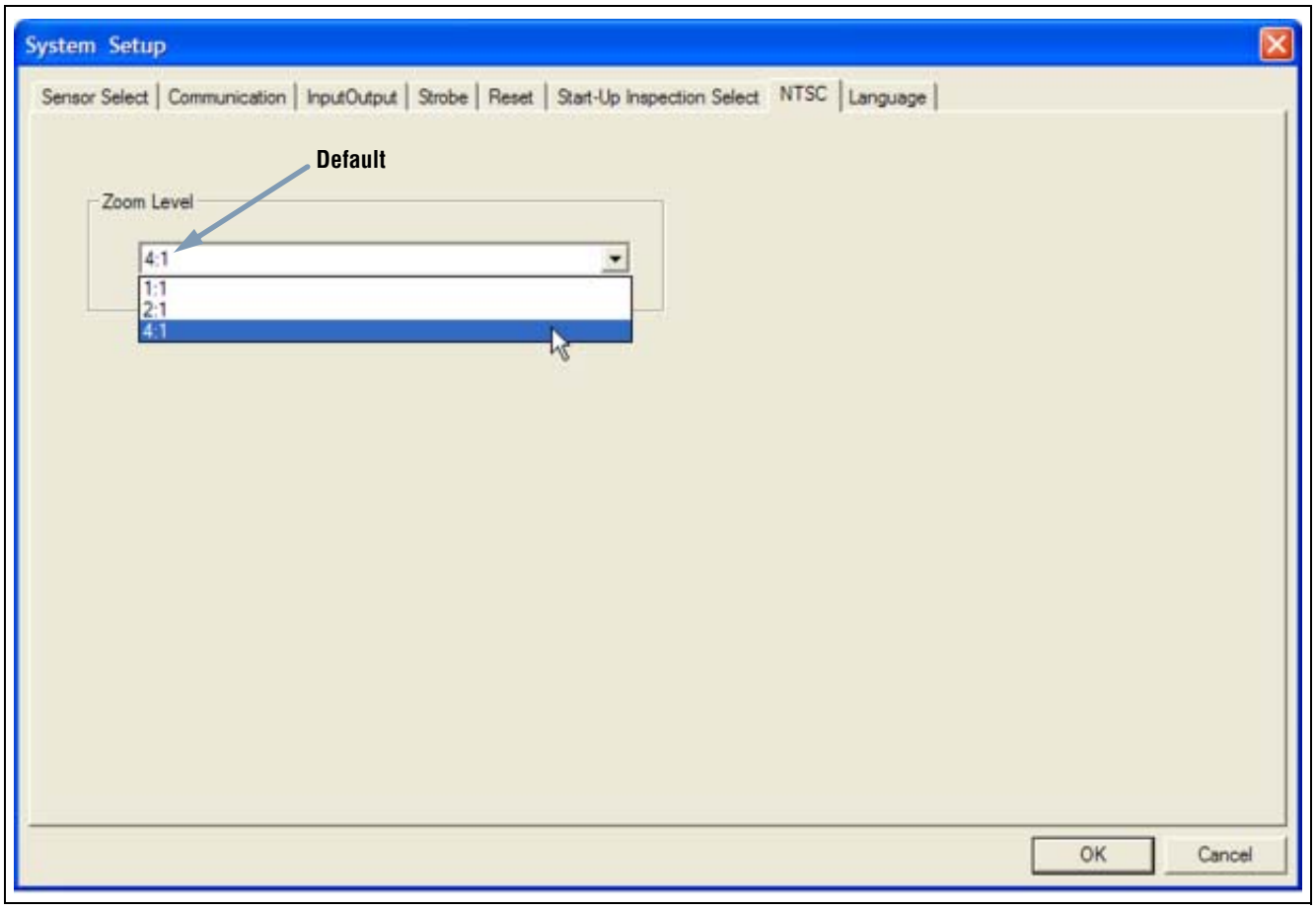



***System Setup Window Start-Up Inspection Select Tab***

Choose **Inspection Name**, then click on the **down** arrow for a drop-down list of up to 12 inspections saved on the Sensor.

This is the inspection that will start if the Sensor is powered down while running an inspection with Hardware Select for inspection selection.

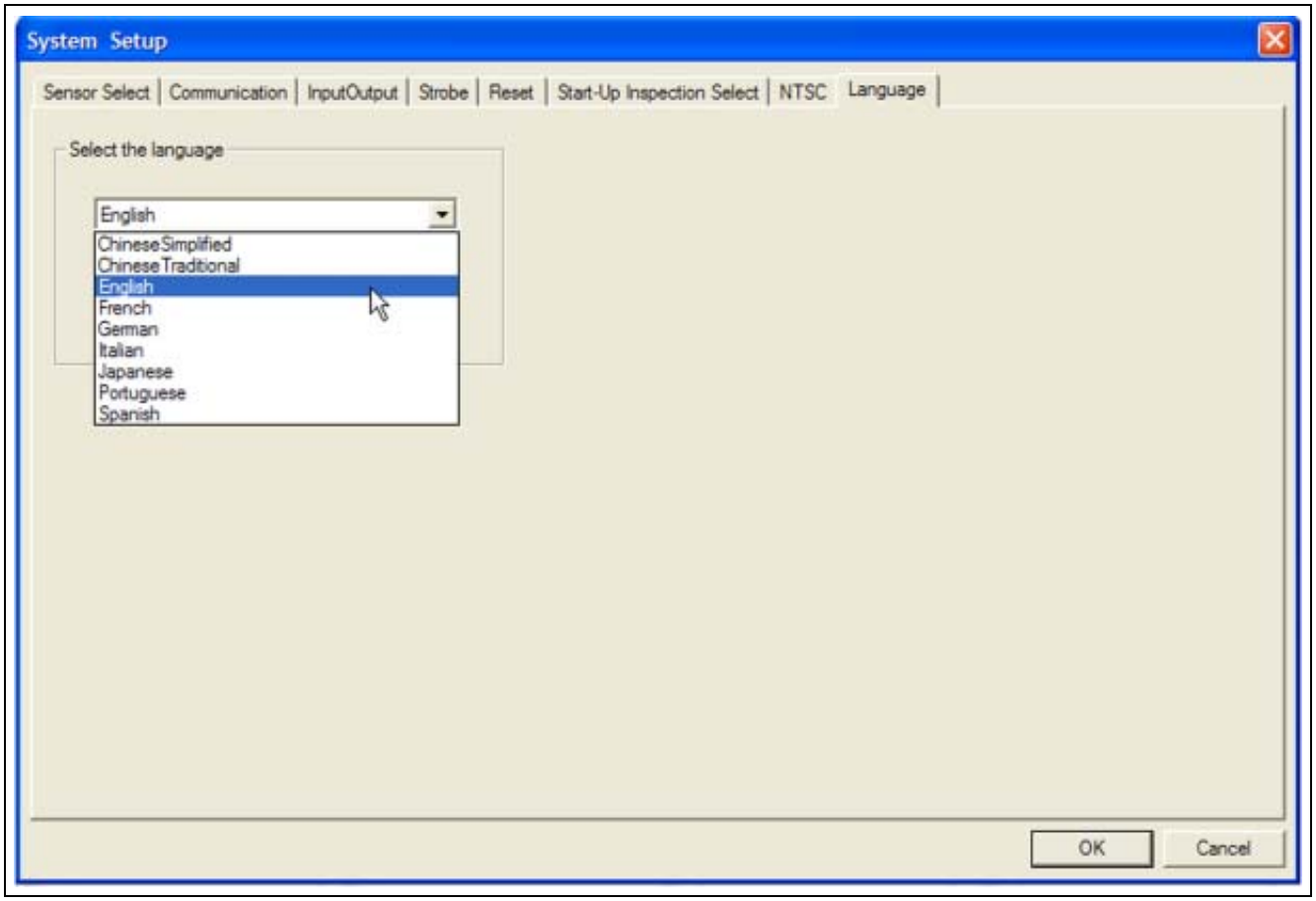
# NTSC Tab




***System Setup Window NTSC Tab***

Choose the desired zoom level of the image window as it will appear on the optional NTSC video monitor. The default **Zoom Level** is 4:1.

# Language Tab




***System Setup Window Language Tab***

Click on the **down** arrow for a drop-down list of the languages installed from the PresencePLUS software CD. Click on the desired language, then click **Apply**. At the next start-up, the PresencePLUS software will use the selected language.

To save changes and exit the System Setup window, click **OK**. To exit the System Setup window without making any changes, click .

# 13. Product Change

This section explains the Product Change (Pin 3) input.

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Product Change and Product Select Timing . . . . . 148

## Product Change, Pin 3

The Product Change input is used in conjunction with one of the four I/O points programmed as a Product Select line. The inspection loaded will be executed following a valid trigger.

- The Product Change input responds to the leading edge transition of a pulse greater than 1 millisecond.
- The Product Select input is pulsed to correspond to a program location. For example, five pulses will load program #5.

See Product Change and Product Select Timing on page 148.

***Product Change Specifications***

| State | Current Sinking (NPN) | Current Sourcing (PNP) |
|---|---|---|
| ON | < 2V at 1 mA max. | > 8V at –7.5 mA max. |
| OFF | > 10V at 4 mA max. | < 2V at –7.5 mA max. |

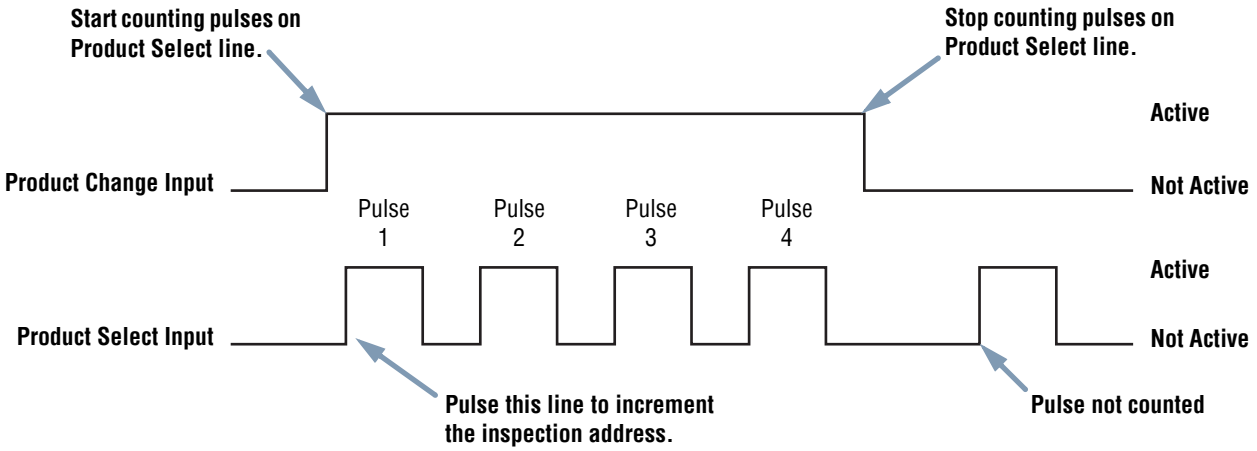
One of the four I/O (See Programmable I/O, Pins 5 through 8 on page 16) must be programmed for Product Select if Product Select is to be used.

***Product Select Input Specifications***

| State | Current Sinking (NPN) | Current Sourcing (PNP) |
|---|---|---|
| ON | < 2V at 1 mA max. | > 8V at –7.5 mA max. |
| OFF | > 10V at 4 mA max. | < 2V at –7.5 mA max. |

# Product Change and Product Select Timing

The Product Change line signals the Sensor to stop what it is doing and begin counting pulses on the Product Select line. The number of pulses indicates to the Sensor the inspection address at which to begin executing the inspection. The only pulses counted are those that occur when the Product Change input is active. As shown in the diagram below, a Product Select input pulse that occurs when the Product Change input is not active is NOT counted.




NOTES:

- The minimum pulse width on Product Select is 1 millisecond active and 1 millisecond inactive.
- In this example, the Sensor will stop executing the inspection it is currently running, go to address number four (because there are four pulses), load the inspection at location four, enter Run mode, and execute the inspection on the next valid trigger.
- If the Sensor is in Run mode, the Product Change line should be activated only when the Sensor is Ready (Green Ready LED is ON). If the Product Change line is activated when the Sensor is in Run mode but performing an inspection (not Ready), the current inspection will be aborted, and the Sensor will proceed to load the inspection at the indicated address.
- If the Product Change line is activated when the Sensor is not in Run mode (Setup mode, for example), then the Sensor will go to the address indicated (address number four in this case) and begin executing.
- The maximum number of pulses is limited by the number of inspections possible on the Sensor.

***Product Change and Product Select Timing Diagram***

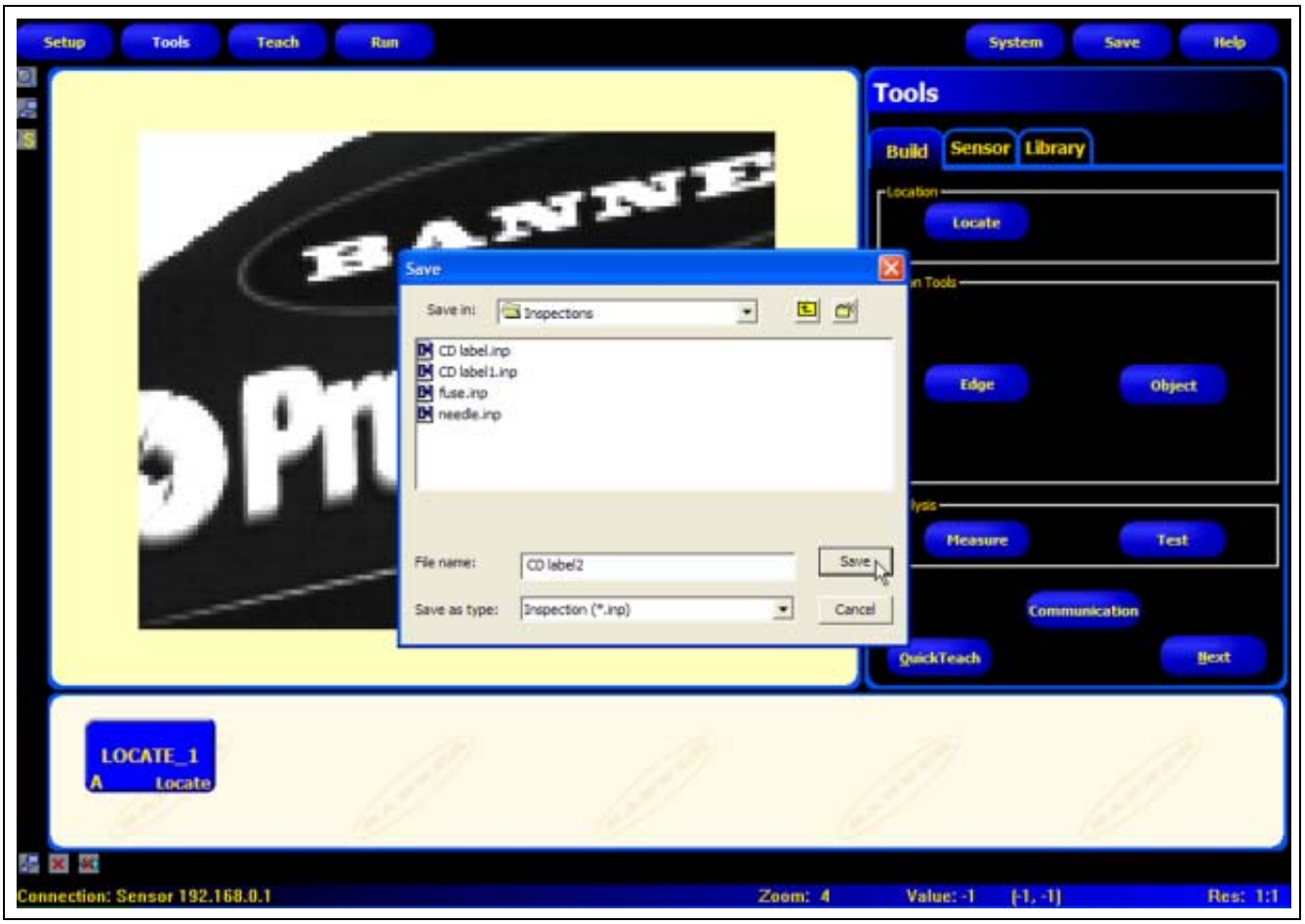
# 14. Saving Inspections

This section explains how to store inspection files on the Sensor or PC.

Save Window . . . . . 149
Inspection (.inp) Files . . . . . 150

## Save Window

Use the Save window to save an inspection to the Sensor or to the Inspections folder on the PC.




***Save Window***

**To display the Save window:**

Click the **Save** button in the Menu toolbar. Options are explained in the following table.

NOTE: The Save window is also displayed whenever the Sensor prompts the user to save something.

***Save Window Options***

| Option | Description |
|---|---|
| Save in Sensor | The Sensor will prompt the user to select one of 12 Sensor locations. |
| Save in Inspections Folder | If an occupied location is selected, the selected filename appears in the **Filename** field. The file being saved overwrites the selected file.<br>To clear a location, delete the file on the Sensor tab. See Selecting or Deleting Inspections from the Sensor (in Section 6, Tools Screen) on page 55.<br>Save the file in any folder on the PC, or create new subfolders. |
| Save as an .inp | Saving as an **.inp** saves the entire inspection. |
| Save as a .bmp | Saving as a **.bmp** saves only the current image. This is available only when saving to the PC. |

# Inspection (.inp) Files

Inspection files can be saved either to the Sensor or to the PC. Inspections must be saved to the Sensor in order to be run.

A copy of the inspection may also be saved to the PC to serve as a backup.

An inspection (.inp) file contains the reference image, image parameters, and inspection parameters:

- The reference image is the image selected in the Setup screen.
- Image parameters are the programmed values that were used by the Sensor to acquire the inspection image. These values include gain, exposure time, and trigger setup.
- Inspection parameters include Location tools, Vision tools, and Analysis tools and their associated parameters.

# 15. Dimensions, Specifications, and Parts

This section provides PresencePLUS P4 dimensions, component specifications, and a list of available parts.

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Right-Angle PresencePLUS P4 Sensor . . . . . 152
Right-Angle Sensor Mounting Bracket . . . . . 153
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Serial Port Communication Specifications . . . . . 159
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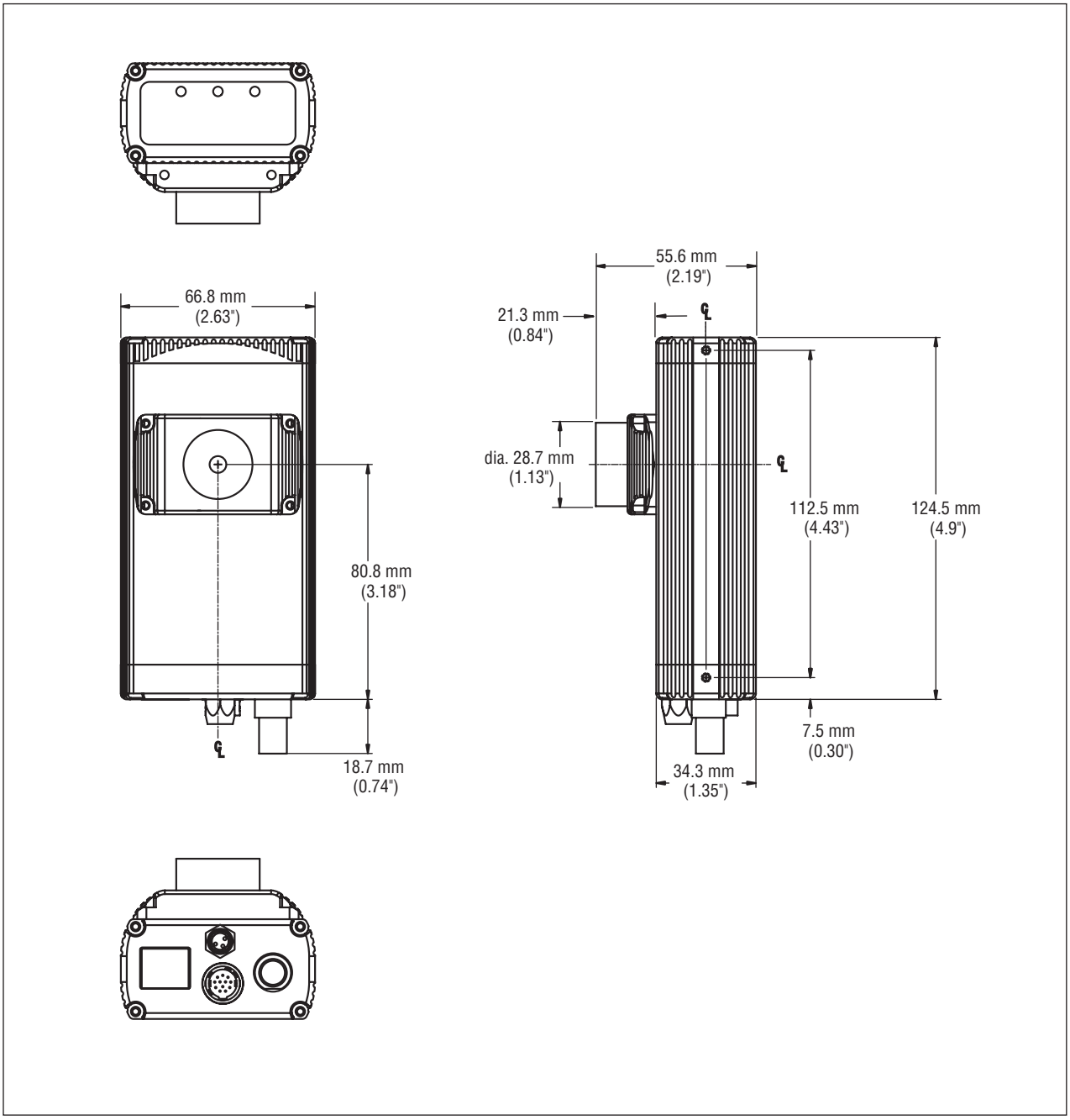
Parts . . . . . 161

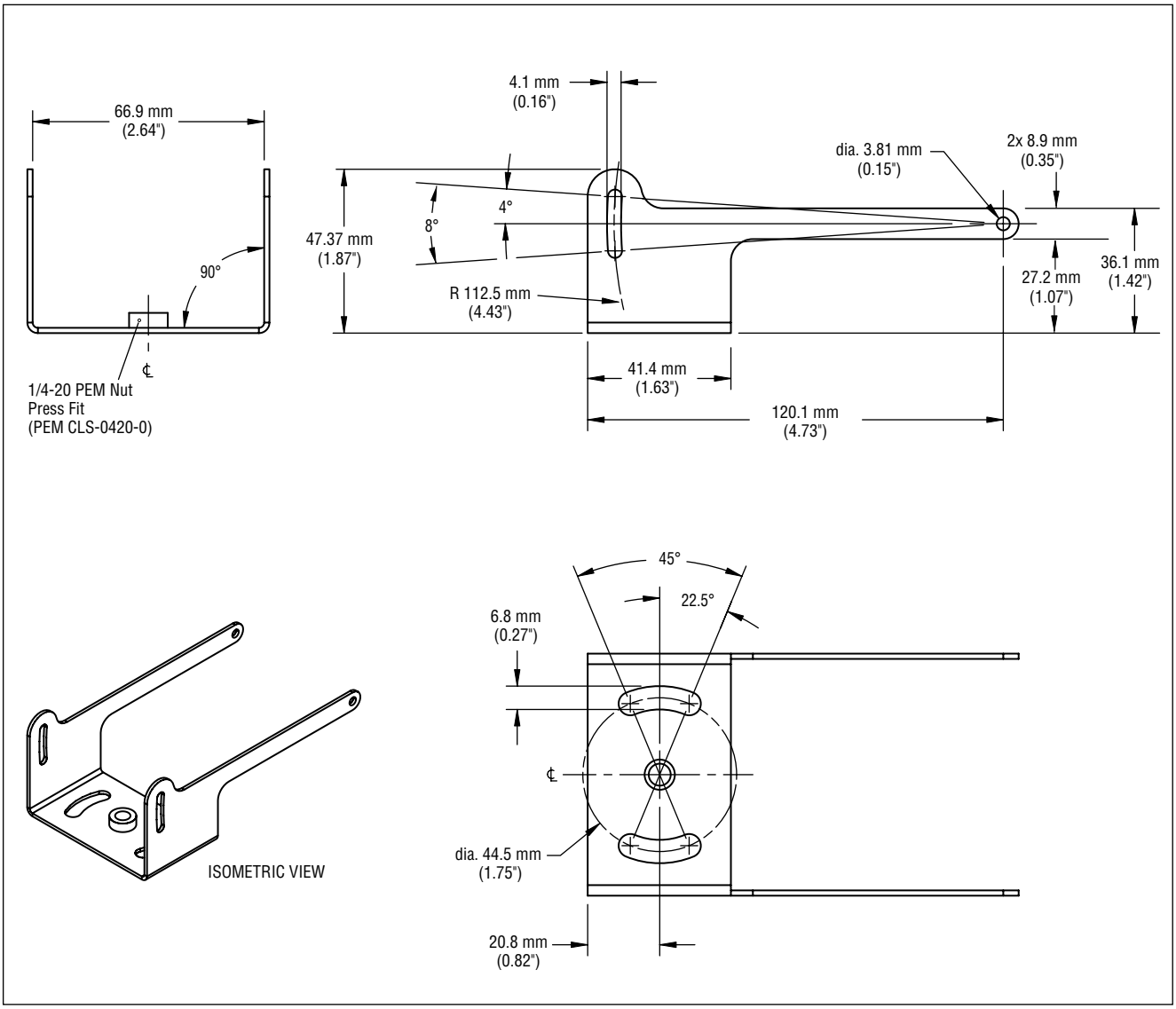
# Sensor and Mounting Bracket Dimensions

## Right-Angle PresencePLUS P4 Sensor



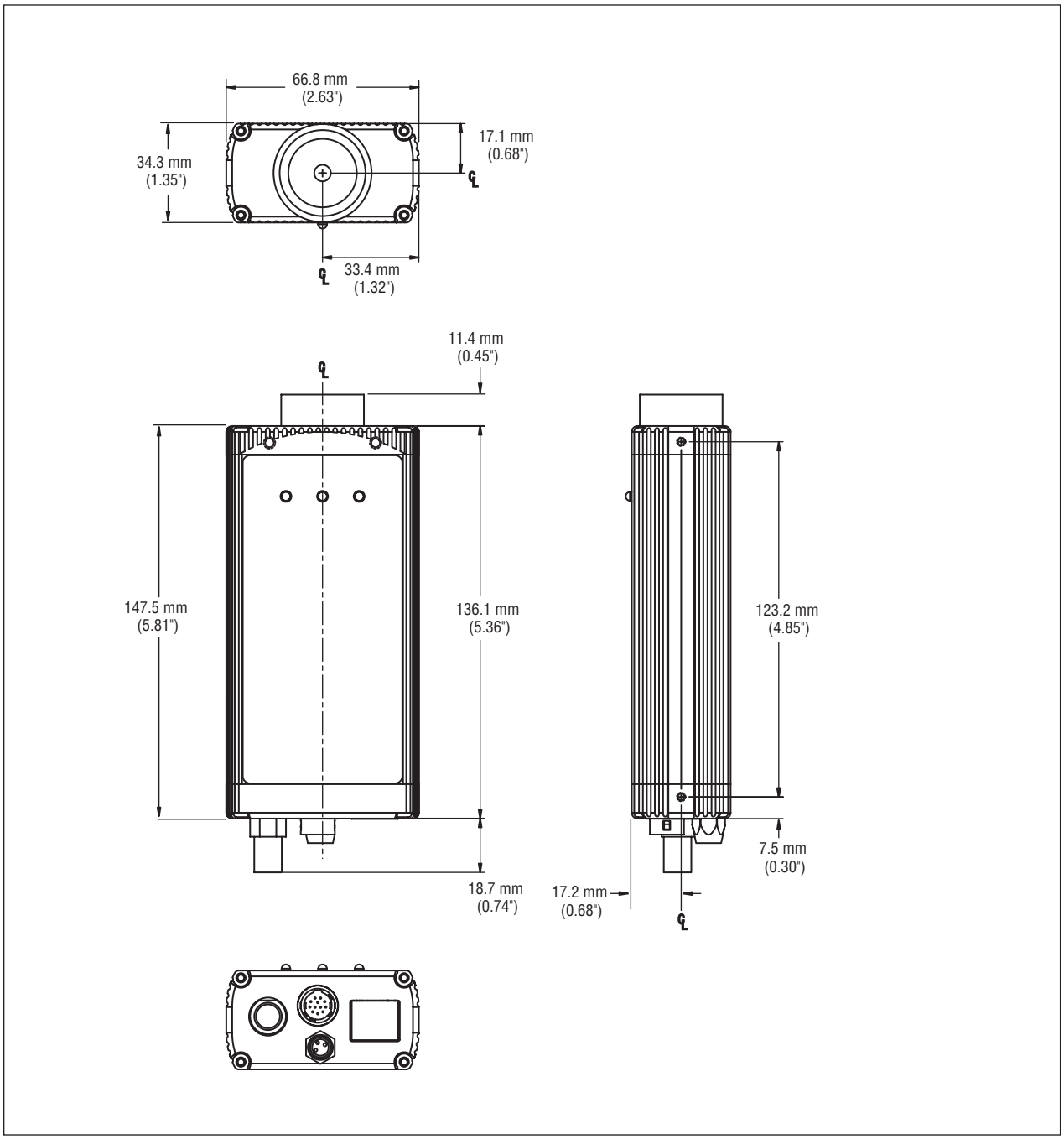

***Right-Angle P4 Sensor Dimensions***

# Right-Angle Sensor Mounting Bracket



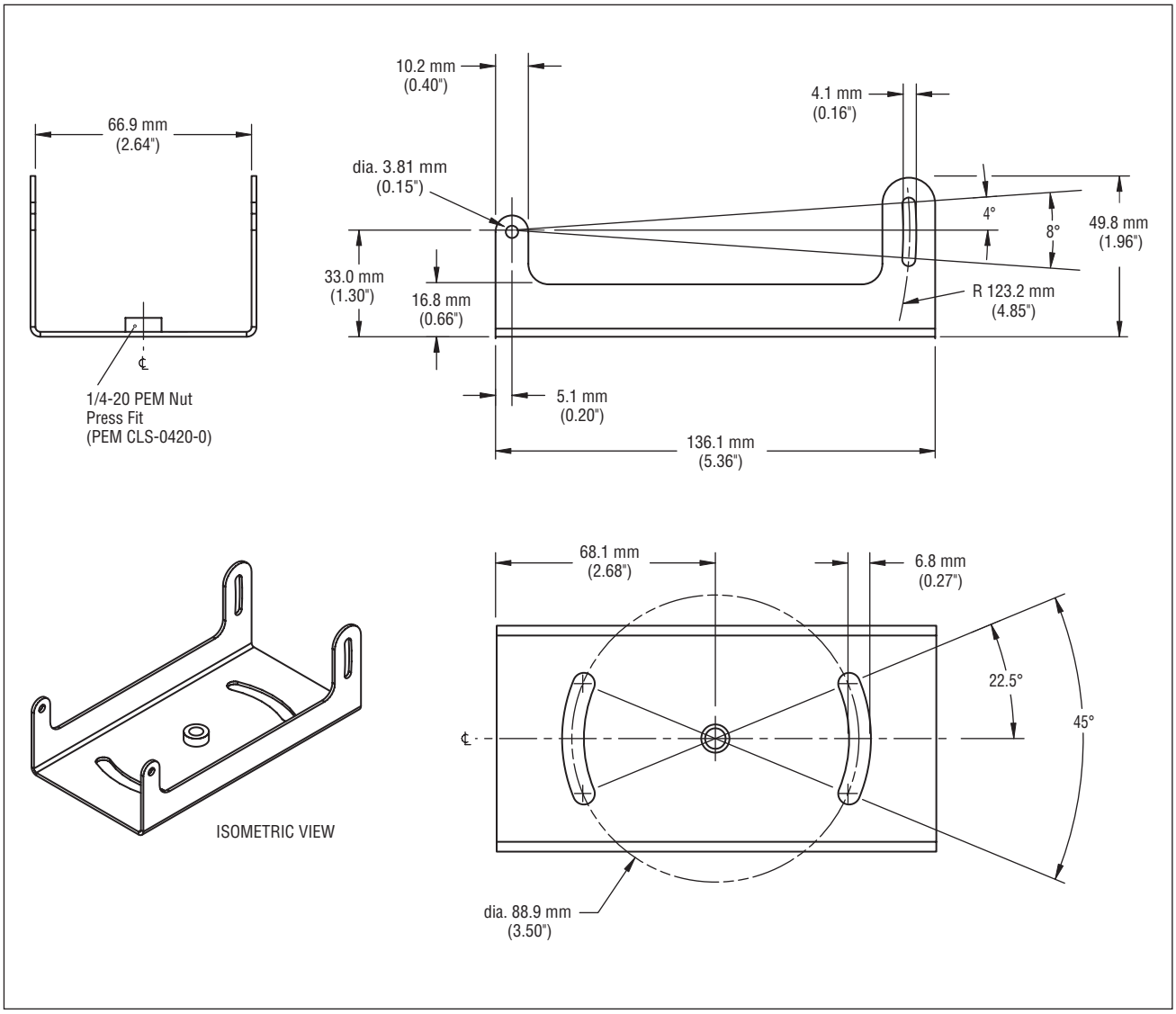

***Right-Angle Sensor Mounting Bracket Model SMBP4RA Dimensions***

# In-Line PresencePLUS P4 Sensor




***In-Line P4 Sensor Dimensions***

# In-Line Sensor Mounting Bracket




***In-Line Sensor Mounting Bracket Model SMBP4IL Dimensions***

# Sensor Specifications

| | |
|---|---|
| **Model Numbers** | **Right Angle:** P4ER<br>**In-Line:** P4EI |
| **Power** | **Voltage:** 10–30V dc (24V dc ± 10% if a light source is powered by the Sensor)<br>**Current:** 500 mA maximum |
| **Discrete I/O** | 1 Trigger IN<br>1 Strobe OUT<br>4 Programmable I/O<br>1 Product Change<br>1 Remote Teach |
| **Input/Output Configuration** | NPN or PNP software selectable |
| **Output Rating** | 150 mA<br>**ON-State Saturation Voltage:** < 1V at 150 mA max NPN; > V ± 2V<br>**OFF-State Leakage Current:** < 100 microamps NPN or PNP |
| **Communication** | - 1 RJ-45 Ethernet<br>- RS-232 flying leads |
| **Display Options** | PC or NTSC video (9 m [30'] max. cable length) |
| **Memory** | Stores up to 12 inspection files |
| **Acquisition** | 500 frames per second max.<br>**Image size:** 128 x 100 pixels<br>**Levels of Gray Scale:** 256 |
| **Exposure Time** | 0.01 to 20.47 ms |
| **Imager** | 2.56 x 2.06 mm (0.10" x 0.08"), 3.25 mm (0.13") diagonal CMOS<br>Pixel size 20 x 20 microns |
| **Lens Mount** | C-mount |
| **Dimensions** | **Right Angle:** 55.6 x 66.8 x 124.5* mm (4.9" x 2.63" x 2.2") H x W x L<br>**In-Line:** 34.3 x 66.8 x 147.3* mm (1.35" x 2.63" x 5.8") H x W x L<br>See pages 152 and 154 for full dimensions.<br>* Measured length does not include connectors or cables. |
| **Mechanical** | **Construction**: Black anodized aluminum<br>**Weight**: Approximately 0.29 kg (0.642 lb.)<br>**Environmental Rating**: IEC IP20; NEMA 1<br>**Operating Temperature**: 0° to +50° C (+32° to +122° F)<br>**Maximum Relative Humidity**: 90%, non-condensing |
| **Certifications** | Approvals in process |

# Monitor Specifications

## 9" CRT

| | |
|---|---|
| **Model Number** | PPM9 |
| **Mechanical** | **Construction:** Metal case<br>**Dimensions:** 220 x 240 x 267 mm (8.66" x 9.45" x 10.51")<br>**Weight:** 6 kg (13.2 lb.)<br>**Operating Temperature:** –10° to +55° C (+14° to 130° F)<br>**Maximum Relative Humidity:** 95%, non-condensing |
| **Electrical** | **System:** NTSC compatible<br>**Picture Tube:** 9" measured diagonally<br>**Horizontal Resolution:** > 1000 TV lines (center), > 800 TV lines (corners)<br>**Power Requirement:** 110–240V ac, 50/60 Hz<br>**Power Consumption:** 0.5A |
| **Certifications** | Listed TV/Video Product 8K37, E133441 |
| **Controls/Connectors** | Horizontal Hold (rotary knob)<br>Vertical Hold (rotary knob)<br>Brightness (rotary knob)<br>Contrast (rotary knob)<br>Video IN-OUT (BNC),<br>Impedance High/Low switch (75 Ohms) |

# 7" LCD

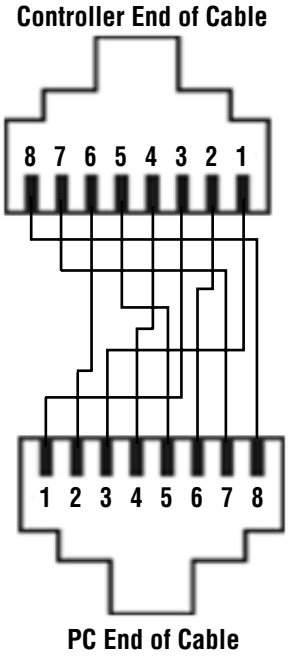
| | |
|---|---|
| **Model Number** | PPM7 |
| **Mechanical** | **Construction:** Black plastic case<br>**Dimensions:** 189 x 117 x 30.3 mm (7.46" x 4.6" x 1.2")<br>**Weight**: 450 grams (15.8 ounces)<br>**Operating Temperature:** 0° to +50° C (+32° to 122° F)<br>**Maximum Relative Humidity:** 95%, non-condensing |
| **Electrical** | **System:** NTSC/PAL autoswitching<br>**Display:** 7" measured diagonally TFT LCD Wide Screen<br>**Resolution:** 1440 x 234 pixels<br>**Viewing Angle:** left 55° / right 55° / top 15° / bottom 35°<br>**Power Requirement:** 10 to 30V dc<br>**Power Consumption:** 1A max |
| **Certifications** | CE |
| **Controls/Connectors** | Buttons on panel and on remote control:<br>- Brightness<br>- Contrast<br>- Color<br>- Tint<br>- Up/down reverse<br>- 4:3 Full/zoom/center/right/left<br>- 16:9 Wide<br>- Video (BNC) |

# Serial Port Communication Specifications

| | |
|---|---|
| **Baud Rate** | 115K |
| **Data Bits** | Eight |
| **Stop Bits** | One |
| **Parity** | Odd |
| **Flow Control** | None |
| **Connector** | See pin descriptions in Cable Connections (in Section 2, System Overview) on page 8. |

# Ethernet Communication Specifications

Use a crossover Ethernet cable for communicating directly with a PC. Use a straight Ethernet cable for communicating with a network device, such as an Ethernet hub or switch.

| | |
|---|---|
| **Protocol** | TCP/IP |
| **Data Transfer Rate** | 10/100 Mbps |
| **Max. Cable Length** | 120 m (393') |
| **Recommended PC IP Address** | 192.168.0.2 |
| **PC Subnet Mask** | 255.255.255.0 |
| **Factory Default Sensor IP Address** | 192.168.0.1 |
| **Connector** | RJ-45 |
| **Connector Pinout**<br>  <br> | Use an RJ45 network crossover cable for direct connection to a PC.<br>**Pin 1:** TXD+<br>**Pin 2:** TXD–<br>**Pin 3:** RXD+<br>**Pin 4:** Not used<br>**Pin 5:** Not used<br>**Pin 6:** RXD–<br>**Pin 7:** Not used<br>**Pin 8:** Not used |

# Parts

| Description | Model |
|---|---|
| **Sensors** | |
| Right-Angle Sensor | **P4ER** |
| In-Line Sensor | **P4EI** |
| **Standard C-Mount Lenses** | |
| 4 mm | **LCF04** |
| 8 mm | **LCF08** |
| 12 mm, focus locking | **LCF12** |
| 16 mm, focus locking | **LCF16** |
| 25 mm, adjustable aperture | **LCF25R** |
| 25 mm, focus locking, adjustable aperture | **LCF25LR** |
| 50 mm, focus locking, plastic, adjustable aperture | **LCF50L1R** |
| 50 mm, focus locking, metal, adjustable aperture | **LCF50L2R** |
| 75 mm, focus locking, adjustable aperture | **LCF75LR** |
| **High-Performance C-Mount Lenses** | |
| 6.5 mm | **LCF06LT** |
| 8 mm, focus locking, adjustable aperture | **LCF08LT** |
| 12 mm, focus locking, adjustable aperture | **LCF12LT** |
| 16 mm, focus locking, adjustable aperture | **LCF16LT** |
| 25 mm, focus locking, adjustable aperture | **LCF25LT** |
| 50 mm, focus locking, adjustable aperture | **LCF50LT** |
| Protective lens cover, UV filter, clear (for all high-performance lenses except 6.5 mm lens) | **FLTUV** |
| **Lens Extensions** | |
| Lens extension kit | **LEK** |
| **LED Ring Lights and Kits** | |
| LED ring light, white, male pigtail, 80 mm x 80 mm | **LEDWR80X80M** |
| LED ring light, green, male pigtail, 80 mm x 80 mm | **LEDGR80X80M** |
| LED ring light, blue, male pigtail, 80 mm x 80 mm | **LEDBR80X80M** |
| LED ring light, visible red, male pigtail, 80 mm x 80 mm | **LEDRR80X80M** |
| LED ring light, infrared, male pigtail, 80 mm x 80 mm | **LEDIR80X80M** |
| LED ring light, infrared, male pigtail, 62 mm x 62 mm | **LEDIR62X62M** |

| Description | Model |
|---|---|
| LED ring light, red, male pigtail, 62 mm x 62 mm | **LEDRR62X62M** |
| LED ring light, white, male pigtail, 62 mm x 62 mm | **LEDWR62X62M** |
| LED ring light, green, male pigtail, 62 mm x 62 mm | **LEDGR62X62M** |
| LED ring light, blue, male pigtail, 62 mm x 62 mm | **LEDBR62X62M** |
| Ring light polarizing kit | **LEDRRPFK** |
| **Area Lights and Kits** | |
| LED area light, white, male pigtail, 80 mm x 80 mm | **LEDWA80X80M** |
| LED area light, green, male pigtail, 80 mm x 80 mm | **LEDGA80X80M** |
| LED area light, blue, male pigtail, 80 mm x 80 mm | **LEDBA80X80M** |
| LED area light, visible red, male pigtail, 80 mm x 80 mm | **LEDRA80X80M** |
| LED area light, infrared, male pigtail, 80 mm x 80 mm | **LEDIA80X80M** |
| Area light polarizing kit | **LEDAPFK** |
| **Backlights and Kits** | |
| LED backlight, visible red, male pigtail, 70 mm x 70 mm | **LEDRB70X70M** |
| LED backlight, infrared, male pigtail, 70 mm x 70 mm | **LEDIB70X70M** |
| **Specialty Lights and Kits**<br>Color and strobe lights also available. Contact your Banner sales representative. | |
| **On-Axis Lights** | |
| 12.5 mm (0.5") Field of View (FOV) | **LEDRO25N** |
| 25 mm (1") FOV | **LEDRO50N** |
| 38 mm (1.5") FOV | **LEDRO75N** |
| **Low-Angle Ring Lights** | |
| 50 mm (2") FOV | **LEDRI100N** |
| 75 mm (3") FOV | **LEDRI150N** |
| 38 mm (1.5") FOV | **LEDRI150N-3** |
| **Dome Lights** | |
| 50 mm (2") FOV, red, classic dome | **LEDRD150N** |
| 50 mm (2") FOV, red, cloudy day illumination | **LEDRC150N** |
| **Regulated Power Supply for Specialty Lights**<br>**Input:** 100–250V ac, 50/60 Hz<br>**Output:** 12V dc ± 5%, 3.5A max | **PSA-12** |

| Description | Model |
|---|---|
| **High-Frequency Fluorescent Lights and Brackets** | |
| 203 mm (8") light, 24V dc | **HFFW8DC** |
| 203 mm (8") light, 110V ac, 60 Hz | **HFFW8AC110** |
| 203 mm (8") light, 230V ac, 50 Hz | **HFFW8AC230** |
| 305 mm (12") light, 24V dc | **HFFW12DC** |
| 305 mm (12") light, 110–230V ac, 50/60 Hz | **HFFW12AC** |
| 356 mm (14") light, 24V dc | **HFFW14DC** |
| 381 mm (15") light, 110V ac, 50/60 Hz | **HFFW15AC110** |
| 381 mm (15") light, 230V ac, 50 Hz | **HFFW15AC230** |
| 610 mm (24") light, 110–230V ac, 50/60 Hz | **HFFW24AC** |
| 915 mm (36") light, 110–230V ac, 50/60 Hz | **HFFW36AC** |
| 1220 mm (48") light, 110–230V ac, 50/60 Hz | **HFFW48AC** |
| Single straight light bracket | **SMBWFTLS** |
| Single right-angle light bracket | **SMBWFTLR** |
| Replacement bulbs and enclosure tubes are available. Contact your Banner sales representative. | |
| **Laser Emitters (Light Sources)** | |
| Small spot laser beam | **QS186LE** |
| Vertical line laser beam | **QS186LE11** |
| Horizontal line laser beam | **QS186LE12** |
| Cross-shaped laser beam | **QS186LE14** |
| **Ethernet Cables** | |
| Cat5e Ethernet cable, straight, 2.1 m (7') | **STP07** |
| Cat5e Ethernet cable, straight, 7.6 m (25') | **STP25** |
| Cat5e Ethernet cable, crossover, 2.1 m (7') | **STPX07** |
| Cat5e Ethernet cable, crossover, 7.6 m (25') | **STPX25** |
| **P4 Sensor Cables** | |
| Cable, 2 m (6') | **P4C06** |
| Cable, 7 m (23') | **P4C23** |
| Cable, 10 m (32') | **P4C32** |

| Description | Model |
|---|---|
| **Mounting Brackets** | |
| Right-Angle Sensor mounting bracket (see page 153) | **SMBP4RA** |
| In-Line Sensor mounting bracket (see page 155) | **SMBP4IL** |
| **Sensor Mounting Columns** | |
| Mounting knuckle assembly kit, with 76 mm (3") extension (contains **a**, **b**, and **c** below) | **SMBPPK3** |
| Mounting knuckle assembly kit, with 152 mm (6") extension (contains **a**, **b**, and **d** below) | **SMBPPK6** |
| **a.** Column bracket knuckle | **SMBPPK** |
| **b.** Column bracket base | **SMBPPKB** |
| **c.** Column bracket 76 mm (3") extension | **SMBPPKE3** |
| **d.** Column bracket 152 mm (6") extension | **SMBPPKE6** |
| **Monitors and Video Cables** | |
| 9" NTSC video monitor | **PPM9** |
| 7" LCD Monitor | **PPM7** |
| Video cable, 2 m (6') | **BNC06** |
| Video cable, 5 m (15') | **BNC15** |
| Video cable, 9 m (30') | **BNC30** |
| **Lens Filters** | |
| Red filter kit | **FLTR** |
| Infrared filter kit | **FLTI** |
| Polarizer filter kit, ring light | **LEDRRPFK** |
| Green filter kit | **FLTG** |
| Blue filter kit | **FLTB** |
| **Software and Documentation** | |
| PresencePLUS CD | |
| PresencePLUS P4 EDGE User's Manual (printed) | **P4LITPKG** |
| PresencePLUS P4 QuickStart Guide (printed) | |
| PresencePLUS Lens Selection Guide (printed) | |
| PresencePLUS Lighting Guide (printed) | |

# Glossary of Vision Terms

## A

### acquisition

The manner in which outside information is brought into an analysis system, as in image acquisition. Generally involves A/D conversion.

### A/D converter

Acronym for Analog-to-Digital Converter, an electronic device that converts data from analog form to digital representation.

### adaptive threshold

A control method in which a threshold is adjusted based on scene content.

### algorithm

A set of well-defined rules or procedures for solving a problem in a finite number of steps, or providing an output from a specific set of inputs. Usually implemented as a computer program.

### ambient light

Light that is present in the sensing environment but not provided by the sensing system.

### angle of incidence

The angle between the axis of an impinging light beam and the axis perpendicular to the sample surface.

### angle of view

1) The angle formed between two lines drawn from the most widely separated points in the object plane to the center of the lens. 2) The angle between the axis of observation and perpendicular to the specimen surface.

### aperture

The size of a lens opening.

### ASCII

Acronym for American Standard Code for Information Interchange. An 8-bit coded character set used to represent alphanumeric, punctuation and certain special control characters.

## B

### backlighting

A condition where the light reaching the image sensor does not reflect from the surface of the object, but comes from behind the object or area of interest. Backlighting produces a silhouette of the work piece.

### band-elimination filter

A filter that suppresses a given range of frequencies, transmitting only those above and below that band.

### bandpass

The specific range of frequencies or wavelengths, passing through a device. Typically measured between points equal to 50% of maximum amplitude.

### barrel distortions

An image appearing to bulge outward on all sides, like a barrel. This is caused by a decrease in effective magnification, as points in the image move away from the image center.

### beam splitter

A device for dividing a light beam into two or more separate beams.

### bimodal

Histogram distribution of values with two peaks.

### binary system

A vision system that creates a digitized image of an object in which each pixel can have one of only two values, such as light/dark, or zero/one.

### BLOB

Acronym for Binary Large OBject. A connected region in a binary image.

### blooming

The "smearing" of regions of the image where the detected brightness is at an excessive level for the receiving element, due to electronic contamination from neighboring bright pixels.

# C

### C-mount

Threaded lens mount developed from 16 mm movie work; used extensively for closed-circuit television. The threads have a major diameter of 1" and a pitch of 32 threads per inch. The flange focal distance is 0.69".

### calibration

The relationship between the output of a measuring instrument and some fiducial mark, an accepted standard of measurement, or other reference datum for the purpose of reporting future results relative to the reference.

### centroid

The X and Y pixel coordinates of the center of mass in a two-dimensional BLOB.

### collimated

A beam of light in which all optical rays are parallel.

### contrast

The range of difference between light and dark values in an image.

### correlation

A process whereby two image segments are compared to determine their similarity, or to find the position at which optimal similarity exists.

# D

### dark field

An illumination technique supplying the illumination at a shallow (grazing) angle to the surface of the work piece. Ordinarily only a negligible amount of light reflects into the Sensor. Specular reflections occur off any abrupt surface irregularities, and are detectable in the image.

### depth of field

The in-focus range of an imaging system. Measured from the distance behind an object to the distance in front of the object, with all objects appearing in focus.

### depth of focus

The range of lens-to-image plane distance having the image formed by the lens appearing in focus.

### diffuse

The process of redirecting incident light over a range of scattered angles, while reflecting from or transmitting through a material.

### distortion

Undesired change in the shape of an image or waveform from the original object or signal.

# E

### edge

A change in pixel values exceeding some threshold between two adjacent regions of relatively uniform values. Edges correspond to changes in brightness corresponding to a discontinuity in surface orientation, reflectance, or illumination.

# F

### feature

Any characteristic descriptive of an image or a region in an image.

### feature extraction

The process of generating a set of descriptors or characteristic attributes from an image.

### fiducial mark

A mark defining a datum point or standard of positional reference used as a basis for calculation or measurement.

### Field of View (FOV)

The area of object space imaged at the focal plane of a lens.

### fluorescent lamp

A lamp that produces light by exciting a phosphor with a plasma, with the phosphor re-emitting the energy as light.

### focal length

The distance from a lens' principal point to the corresponding focal point. Also referred to as the equivalent focal length and the effective focal length.

### front lighting

An arrangement in which the object is illuminated and viewed from the same side.

### f/stop (or f/number)

Ratio of the focal length of a lens to the diameter of its opening. Increasing or decreasing an exposure by one f/stop doubles or halves the amount of light allowed through the lens.

# G

### gradient magnitude

The rate-of-change of pixel intensities over a small local neighborhood.

### gray scale

Standardized variations of values from white, through shades of gray, to black in a digitized image with black assigned the value of zero and white the value of 255.

# H

### halogen

A gas, such as iodine, placed inside an incandescent lamp to gather the evaporated filament off the bulb and redeposit it back onto the filament.

### high pass filter

A processing operation that enhances high frequencies (and attenuates low frequencies).

### histogram

Frequency counts of the population of pixels of each intensity (gray level) or other characteristic populations in an image.

# I

### incandescent

Thermal generation of light, usually through radiant filaments in a bulb.

### incident light

The light falling directly on an object.

### inverse square law

The exponential relationship between increased distance and decreased light intensity.

### iris

An adjustable aperture built into a Sensor lens to permit control of the amount of light passing through the lens.

# L

### LED

Acronym for Light-Emitting Diode.

# M

### mask

A pattern used to eliminate portions of another pattern. Regions of an image at a constant value, usually white or black, form the mask.

# N

### noise

Irrelevant or meaningless data resulting from various causes unrelated to the source of data being measured or inspected; random undesirable video signals.

# O

### OCR

Acronym for Optical Character Recognition. Recognition of each character in a string by a vision system.

# P

### parallax

The difference in appearance or position of an object when viewed from two different locations.

### photon

A particle of light. A quantum of electromagnetic energy moving at the speed of light.

### pincushion distortion

A visual effect where the sides of an image appear to bulge inward on all sides like a pincushion. Caused by an increase in effective magnification, as points in the image move away from the image center.

### pixel

Acronym for picture element.

### polarization

The restriction of the vibrations of light or magnetic field vectors to one plane.

### polarized lighting

The use of polarizing filters to remove specular reflections from a scene to be viewed. Typically, one polarizing filter is placed in front of the light source and a second filter is placed over the receiver with the two filters offset in their polarizing direction by 90 degrees.

### preprocessing

Enhancement, transformation, or filtering of images before processing.

## R

### recognition

A match between a description derived from an image and a description obtained from a stored model or feature set.

### Region of Interest (ROI)

The area inside defined boundaries to be analyzed.

### repeatability

The degree to which repeated measurements of the same quantity vary about their mean.

### resolution

1) The smallest detectable change in position or size of an object. 2) The closest distance between two objects (points) in an image, identifiable as two separate objects rather than one object.

## S

### shift register

An electronic circuit consisting of a series of storage locations (registers). During each clock cycle, the information in each location moves (shifts) into the adjacent location.

### signal-to-noise ratio

The ratio of the maximum value of an output signal to the standard deviation amplitude of the noise on the signal.

### strobe light

A pulsed illumination source that generates short bursts of high-intensity light.

### sub-pixel resolution

Any technique resulting in a measurement with a resolution (interpolated position of change) of less than one pixel.

## T

### template matching

Comparing a template with an object in an image. Usually performed at the pixel level, as with a template correlation.

### threshold

The intensity (specific pixel value) below which a stimulus produces no effect or response. Often used to convert a gray scale or analog image into a binary image.

### thresholding

A scene segmentation process based on converting a gray scale image into a binary image by reassigning pixel gray levels to only two values. Regions of the binary image are separated, based on whether pixel values in the gray scale image were above or below a chosen intensity level.

### throughput

The total capability of equipment to process or transmit data during a specified time period.

### tolerance

The established range upon which to base the differentiation between good and bad products.

### translation

Movement left or right, up or down, but not rotated; a geometrical operation that shifts the position of an image from its original position.

## Z

### zoom

Electronically or optically enlarging or reducing the size of an image.

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**WARRANTY:** Banner Engineering Corp. warrants its products to be free from defects for one year. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture found to be defective at the time it is returned to the factory during the warranty period. This warranty does not cover damage or liability for the improper application of Banner products. This warranty is in lieu of any other warranty either expressed or implied.

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